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Electrical World

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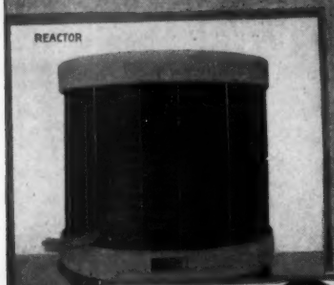

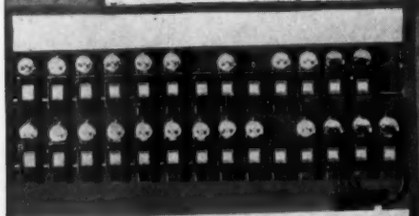

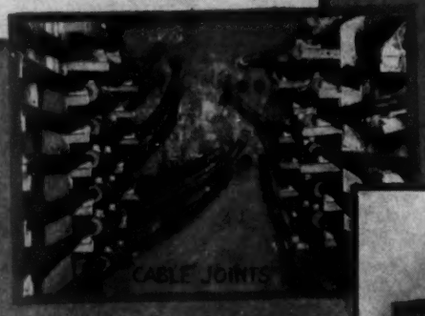

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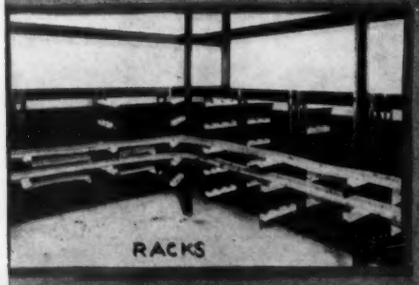

Electrical World

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W. H. ONKEN, JR.
Editor

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Canada's Interest in St. Lawrence Water Power

THE rejection at this time by Canada of Washington's proposal that the two governments confer on the proposed St. Lawrence waterway is another indication of her lack of interest in the scheme. Politically, the Mackenzie King government would gain little and lose much by adopting the plan, first and most important because of lack of funds and secondly because of the opposition of Quebec. It is futile to try to sell a man a twelve-dollar pair of shoes, however superior they may be, if he can afford to pay only half that price, and particularly if the lower-priced shoes are more suitable for his purpose.

Economically, the industrial section of Canada feels, and perhaps with justification, that there is ample and cheaper power available in wholly Canadian streams which are as yet untouched. When the enormous potential output of the great rivers contained within her own boundaries is all disposed of and the turbine installations throughout Ontario and Quebec become many times what they are at present, Canada may turn her thoughts to the St. Lawrence. So long as that mighty stream remains of chief interest only to persons on this side of the border and to the people of eastern Ontario, no action on the St. Lawrence waterway project is likely.

Worcester Accepts the Challenge

BY APPEAL to the federal courts for the injunction which has been granted against the recent order of the Massachusetts Department of Public Utilities reducing its maximum rate from 7 cents to 5 cents per kilowatt-hour, the Worcester Electric Light Company has taken steps to protect its stockholders. If the case follows the normal course, the Supreme Court will in due time pass upon the validity of the commission's finding, which involves much interest on account of the rival theories of valuation at stake. As has been pointed out before, the reproduction-cost-less-depreciation rate base, already sanctioned by the highest court in the Indianapolis Water Company case, has been taken by the Worcester company as the basis of its appeal. Massachusetts valuation practice, on the other hand, is predicated on prudent investment, and in this instance there is a difference of about 80 per cent between the company's valuation and the maximum figure named by the Massachusetts commission.

The financial strength of the Worcester company would have enabled it to test the economic accuracy of the commission's forecast without impairing its credit had the management elected to try the 5-cent rate for a year or so in the prosperous and compact territory it serves. Had public sentiment dictated such a trial, it probably would have been made; but in view of the company's maximum rate of 7 cents popular interest in the situation apparently was too small to sway the company toward acceptance of the commission's order. In fact, a good deal of sentiment commending the company for carrying the case to the courts has been evident in Worcester business circles. It is well to remember that a strong body of opinion exists in the utility industry in favor of determining the validity of the Massachusetts theory of rate regulation in the face of the reproduction-cost theory, and not a few thinkers believe that a decision on this matter by the highest court would most acceptably clear the air.

Legal and Promotional Types of Rates

THERE are certain matters connected with the question of rates which deserve elucidation. We have had occasion before to editorialize on legal versus common-sense rates. Using the Worcester case as an example, we are firmly convinced that the lower rate, coupled with an aggressive advertising and sales campaign, will prove profitable. We are just as firmly convinced that by doing nothing to stimulate business and by insisting on its legal rights the Worcester company can prove the lower rate confiscatory. Taking the whole history of regulation in Massachusetts into consideration, we doubt if any public utility company can justly claim that the Massachusetts commission has been unfair. The financial strength of the public utility companies of Massachusetts is the best evidence of the fact that regulation there has been sensible, prudent and, from a financial viewpoint, wise.

We believe that the history of this case already justifies renewed emphasis upon the importance of promotional-type rates to this industry as a political solvent no less than as a means of economic progress and the building up of the best possible public relations. The opportunity afforded the customer to earn lower rates per kilowatt-hour as his use of service increases is easily grasped by the public and offers miserably poor material for attacks by politicians and others seeking advantage through assaults upon current prices of electricity. We have no desire to "lay down the law" to Massachusetts utility executives in this connection, but it would seem as though the situation could be greatly stabilized by a still more general adoption of promotional-type rates throughout the Bay State. Considerable headway has already been made in this direction, and in view of the results attained it seems reasonable to conclude that small ground exists for gloomy forebodings as to the future of either private ownership or commission regulation should the highest court fail to uphold the Massachusetts doctrine. On the other hand, if the Supreme Court sustains the commission, promotional rates are still available to all companies as an alternative means of seeking both public and official approval. Propagandists of the Pinchot type may seek to discredit those who exercise their privilege as corporate citizens to determine their rights in the courts, but it is the simple

truth that no sound management in the power industry today has the slightest idea of embarking on the fatuous course of general price increases; in fact, the trend is in just the opposite direction.

Reduce Losses by Good Housekeeping

SUMMER days should be used by electric utility companies in attempts to reduce system losses. In the pressure of giving service to customers and in the race to serve large areas there has grown up on most properties a network of unco-ordinated and often poorly engineered lines and feeders. This has meant large line losses and increased investments per unit of service. Records of generated energy and of energy actually sold show losses ranging from 10 to 20 per cent.

These losses can and should be reduced. A thorough study of system layout, system loads and system installations should be made, and if done on a piecemeal basis the cost is negligible as compared with the benefits. Several utilities have reduced their system losses from 5 to 10 per cent by simply introducing good housekeeping methods whereby they know the loads on transformers and lines and adapt the transformer sizes, transformer locations and copper sizes to the situation. Tests on transformers, meters, lines and distribution circuits should be made frequently, and extensions should be planned carefully. Incidental benefits obtained are better voltage regulation, greater standardization and a reduction in investment.

With the great economies recently obtained in power generation at the expense of much time and money, it is rather astonishing to find out on the system a general neglect, resulting in conditions which make for waste and cost and which can be easily improved.

Turn Residence Statistics Into a Flail

IF ALEXANDER POPE thought it wise to warn mankind of the danger of a little learning, what would he say about statistics were he alive today? For we are indulging to excess in loose figures in this generation. And it is not the figuring of liars that makes the figures lie to us, but more often the marshaling of smug statistics in ponderous array, without the lesson of them thought through and organized for action.

As an example may be cited figures giving the cost of serving the residence consumer. Experts on cost allocations and expert statisticians argue and compile long columns of figures to show this cost to be this or that. Maybe the cost of serving a home is $30. Maybe it is a little less or a little more. This fact should not be a gloom producer. The point is that here is an industry with sixteen million customers who do little more at best than pay their way. The cost of serving them cannot be made much less. But a little real selling will double the income and make each customer profitable. Instead of centering his interest on merely producing this high cost figure, therefore, let the statistician remember that, after all, he is engaged in a business enterprise. And let him use that figure as a flail to bludgeon the executives of this industry once again with the tremendous financial advantage that can be gained by developing larger sales to all these domestic customers. With this kind of a constructive application figures are worth much to the industry.

Purchased Power Accepted in Railroad Electrification

ELECTRIFIED railroads should purchase power from light and power utilities if they expect to get the cheapest and best power for their operations. This contention of the utilities was not agreed to by the railroads for many years. They felt that it was equivalent to granting control of motive power to outsiders, and tradition and conservatism dictated a policy whereby all railroads would be self-contained.

But the present electrification situation shows that the railroads are ready to adopt the power policy proposed by the utility. The electrification of the Illinois Central in Chicago was based on purchased power. Last week the Pennsylvania Railroad contracted to purchase power from the Philadelphia Electric Company for present and future electrification projects. The significant item in this contract was the term of twenty years. Conservative railroads do not make long-term contracts without being convinced of their merit by a thorough investigation.

The enterprise of the utilities concerned and the examples set by these railroads afford national evidence of the proper way to handle power requirements in railroad electrification and should spur on central-station companies to accelerate the rate at which railroads are being electrified.

Interconnection and Plant Development

APPARENTLY nothing can stop the economic progress of interconnection when based on sound engineering. From the first, emphasis has been laid upon the capital savings resulting from the reduction of surplus plant capacity by the use of proper tie lines, and countless examples might be cited of postponed investment in generating stations and equipment due to the intelligent application of interplant "hook-ups." Less has been said about the relation of interconnection to plant development, but the opportunities to use capital more intensively are present here as well as in the more familiar field of decentralizing reserve capacity.

Take the case of a hydro-electric development whose ultimate annual capacity in kilowatt-hours considerably exceeds that initially warranted by the market within economic range of the station. In a representative instance the plant may serve an area with a radius of 30 or 40 miles and meet all requirements of load with a partial development of the available water storage facilities, the excavation of less than the ultimate tailrace cubic yardage, and with the installation of perhaps two out of three complete waterwheel-generator units. Surplus space also exists on the transmission-line right-of-way because of fractional development of the ultimate rating of the project. Under these conditions the absorption of the output by local markets only may reveal to the engineer a relatively high cost of construction and operation per kilowatt or per kilowatt-hour. The enterprise may do very well within its limitations and the owners may be fully justified in postponing the ultimate development of plant and lines, but under such conditions it may well prove true that the isolation of the development with respect to regional power supply is a source of more or less economic loss.

Interconnection, if warranted by adequate engineering analysis, raises the development to a new plane of usefulness. From the outset it insures better handling of

water from the existing installation because of the absorbing power of a broader market, with its inevitable increased diversification of demands and energy consumptions. Reliability of service may be increased under proper operating conditions—a factor of literally tremendous importance in obtaining and holding contracts for power supply to industries and institutions where interruptions to processes and activities of various kinds must be cut to the lowest possible number and duration if customers are to remain satisfied and new business secured in critical fields. Beyond this lies the completion of the initial or partially developed project, with its implied use of full storage facilities, with completion of dams to ultimate height, provision of the full complement of generating units and hydraulic equipment, construction of the final and probably symmetrical step-up transformer and switching station facilities, with possible provision of a more flexible layout to meet emergencies and insure greater efficiency in handling output, the erection and use of complete transmission lines, and so on down to the excavation of the tailrace to develop maximum head. In a word, interconnection based on sound engineering serves to bring into full economic use a well-rounded project, assuming mutually profitable contractual arrangements between the owners of the adjacent plants where common ownership does not prevail, and suitable analysis and co-ordination of resources where the plants are tied into a single property.

Improving Station Take-Offs

IN MANY respects the facilities used by not a few companies for taking energy away from generating plants have not kept pace with the best practice in station design as a whole. Architects and engineers realize the importance of good-looking buildings and reliable, safe and convenient arrangement of equipment generally; but as one goes about the country there are still too many instances apparent of take-offs which appear to have been built as afterthoughts, thrown together without much study of conditions and insufficient regard for harmony of construction between plant and line. City stations utilizing more and more underground ducts for take-off service are rapidly getting away from these criticisms, but in hydro-electric plants situated where land is cheap and where visitors are few there is opportunity for betterment.

Local conditions control take-off designs, and these must vary widely in different cases. However, all such structures ought to be beyond complaint on the score of mechanical stability, insulation, spacing and safety of access. The trend toward wider use of outdoor transformer and switching stations even in moderate voltage installations is helpful, and the use of underground cables to carry generator output to circuit-breaker and bus structures from which the outgoing lines are fed contributes to flexibility and appearance, since it often enables the switching installation to be placed far enough from the building to permit designing and operating a first-class layout. The power industry has something to learn here from telephone engineering practice, with its effective use of distributing frames and cable-line structures. A little study will show the engineer where he can safeguard operators, service and proper appearance in take-off designing, and in many instances structures now hazardous and bad-looking can be rebuilt or improved at but moderate cost when measured against the value of high-grade construction.

Water Heaters as Load-Factor Aids

THERE is wholesome logic connected with the report of the committee on water heaters of the Empire State Gas and Electric Association. Water heaters offer a means of increasing domestic consumption. Load factors should be improved. Combine the two desiderata. If water heaters can be operated at night, load factors will be improved. If night operation is to be accomplished, a small heating unit and relatively large storage tank must be used. This, of course, is contrary to established practice, but has many compensating advantages. An attractive rate is, of course, necessary.

There is too little recognition of the real value of improving load factors. Too many executives and operating officials look upon the load factor as a desirable thing to improve because of the value of filling in the low spots in a load curve and overlook the value of this possible night load, which by offering increased use of equipment burdened with a heavy overhead allows a lower cost per unit of energy delivered, through a reduced cost of production, by spreading the overhead over more units. Utility companies have been slow to realize the value of promotional and inducement rates. It would be well worth while in many instances to sell energy at a lower rate for night use than for daytime service. It is a phase of supply and demand. The consumer who is willing to take his supply when the majority of the users are not doing so deserves encouragement, particularly as he is, in a way, doing the utility no small favor, though he need not be aware of it.

Water heating for domestic purposes deserves an attractive rate, and if it can be instituted as an off-peak business, such a rate can more readily be given.

The Nation's Ice Bill

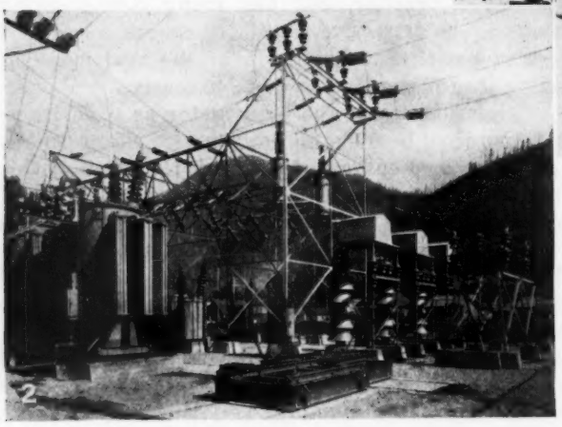
ASIDE light is thrown on the possible market for artificial refrigeration by the recently published report of the results of a survey by Leslie C. Smith, secretary of the National Association of Ice Industries. Though refrigeration in the United States now is consuming more than $1,300,000 worth of ice a day, or an average of $40,000,000 a month, it is held that the industry has as yet developed only a small portion of the market. Only 40 per cent of American homes have refrigerators, and of the 12,000,000 present users of ice, only 17 per cent take ice the year round.

These statistics are not without interest to the central station, whether it is in the ice industry itself, as is true in some of the Southern states, or sells energy for the operation of commercial or residential refrigerating plants. According to the figures quoted, there are only three-quarters as many families having refrigerators as there are residential electrical customers. Of those having refrigerators clearly the best prospective customers for electric refrigeration are those using ice the year round, numbering about 2,000,000.

Domestic electric refrigeration has stimulated activity on the part of the ice industry. In the long run the present competition will probably prove to have increased the business of both. There are homes in which the former is at present clearly out of the question, but many of these may be potential purchasers of ice. There are other families well able to make the initial investment for securing the cleanness, reliability and other advantages of electric refrigeration. Development of either kind is likely to increase the business of the other.

Great Northern's 25-Cycle 11,000-Volt Electrification

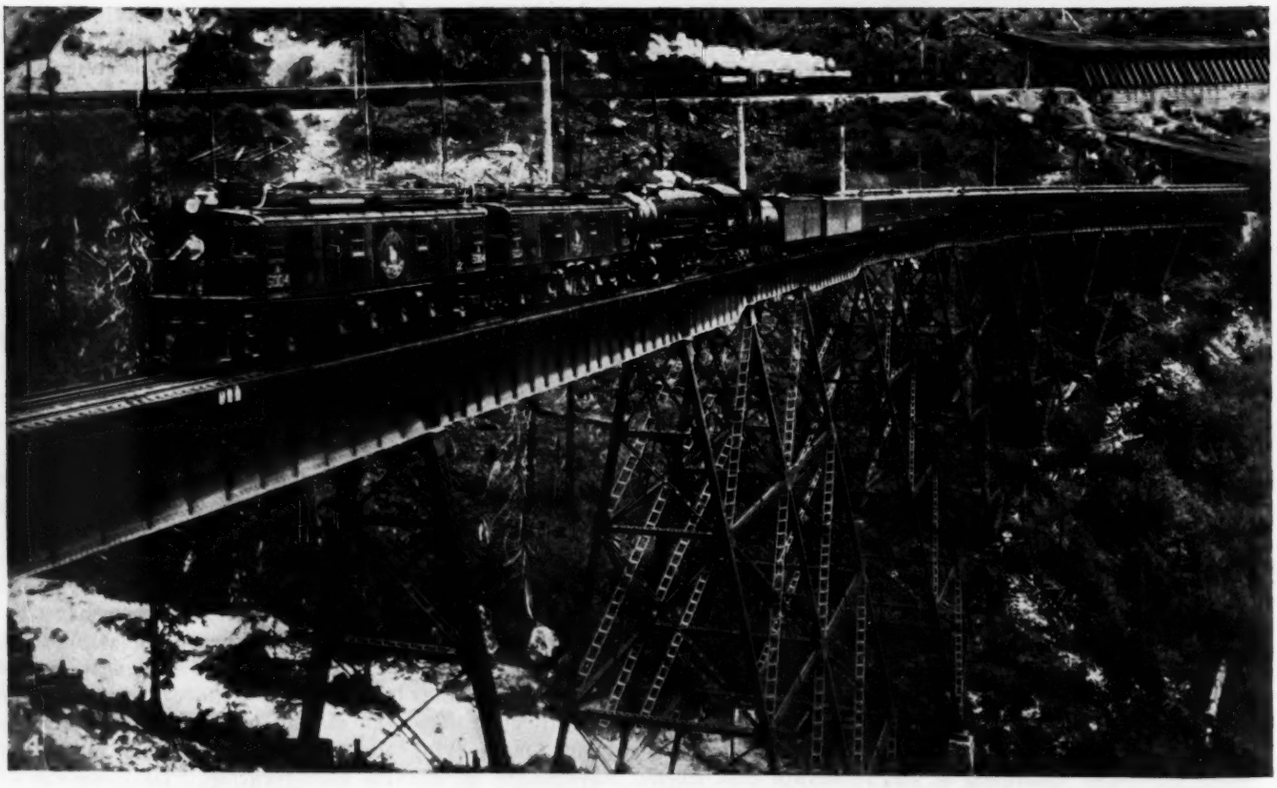
1



2

IN FEBRUARY the Great Northern Railway placed in operation two electric locomotives on a 26-mile section of its main line over the Cascade Mountains in western Washington. Power is purchased from the Puget Sound Power & Light Company at 110,000 volts, 60 cycles, and is stepped down and converted to 25-cycle, 44,000-volt, single-phase energy at the Skykomish substation. Two transmission lines of this rating parallel the railway, feeding the contact line at 11,000 volts through step-down transformers along the right-of-way. Each locomotive has eight driving motors rated at 560 hp.

3



4

Economies of

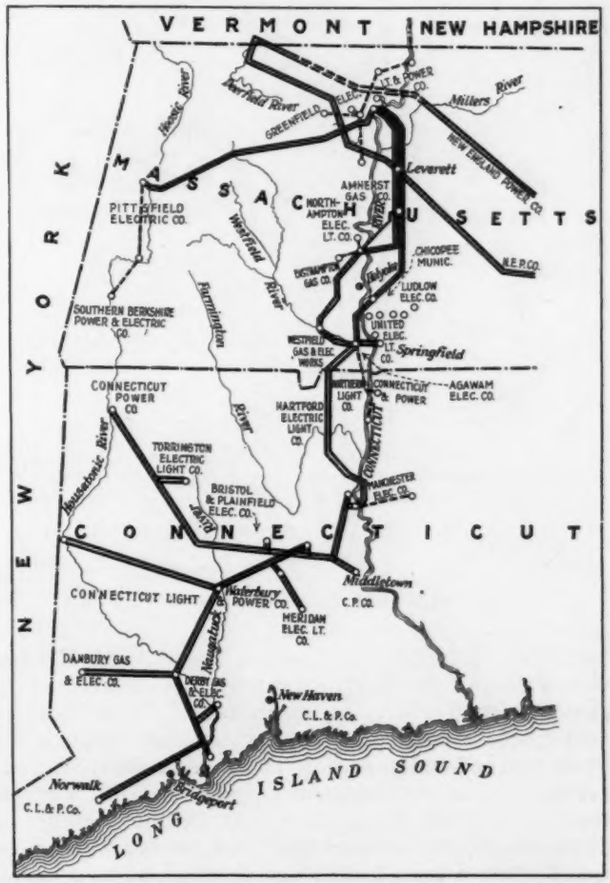
Connecticut Valley Power Exchange

Résumé of an Important New England Interconnection Development—Notable Savings in Operating Costs Attained and Plant Extensions Postponed as Service Is Improved

TWENTY-TWO months' operation of the Connecticut Valley Power Exchange terminated at the close of 1926 with net savings of $221,380.72, resulting from the interconnection of the systems of the Hartford Electric Light Company, the United Electric Light Company of Springfield, the Turners Falls Power & Electric Company, the Connecticut Power Company and the Connecticut Light & Power Company. Through the courtesy of J. Gardner Coolidge of the Harvard Graduate School of Business Administration, who recently prepared a case study of this interconnection, and of Samuel Ferguson, president of the Hartford and Connecticut Power companies, the following account* of the work of the exchange is presented.

In 1924 the Hartford, United and Turners Falls companies, three independent utilities serving the principal industrial communities in the middle Connecticut valley, were confronted with the common problem of obtaining additional generating capacity in order to carry their increasing loads. The load of the Hartford company was approaching the point at which no reserve margin existed in case of accident to its largest unit, and the two other companies were in much the same situation. This compelled consideration of the advisability of individually increasing station capacities or of pooling resources and providing for future additions with the latter possibilities as a factor in such decisions. It was evident that for each company to make separate plant additions would be uneconomical if, by interconnecting their stations and pooling their generating facilities, the combined load could be carried by existing facilities with sufficient margin for reserve. Accordingly a comprehensive plan was prepared for interconnecting the "power centers" at Hartford, Springfield and Turners Falls and for exchanging power among the three companies to the advantage of each.

The Turners Falls company operated hydro-electric developments aggregating about 58,000 kw. and a steam relay station of 24,000 kw. These stations, together with the company's transmission lines, substations and distribution system, represented an investment of about $15,000,000. The company wholesaled power to about 40 industrial and utility companies located in the Connecticut and Housatonic valleys. Annual sales of power were about 188,000,000 kw.-hr., of which 42,000,000 kw.-hr. was disposed of as surplus. Power was interchanged with the New England Power Company, the largest hydro-electric company in New England, and to a lesser degree with the United company.



MAP OF INTERCONNECTING LINES, CONNECTICUT VALLEY POWER EXCHANGE

The United company operated a steam station having an effective capacity of about 35,000 kw.; it also had hydro-electric capacity of 3,000 kw., consisting of two small stream-flow developments. This company supplied light and power in Springfield and the surrounding towns, serving a population of about 150,000. The company's plant and equipment represented an investment of about $9,500,000. Annual sales of electricity were approximately 95,000,000 kw.-hr.

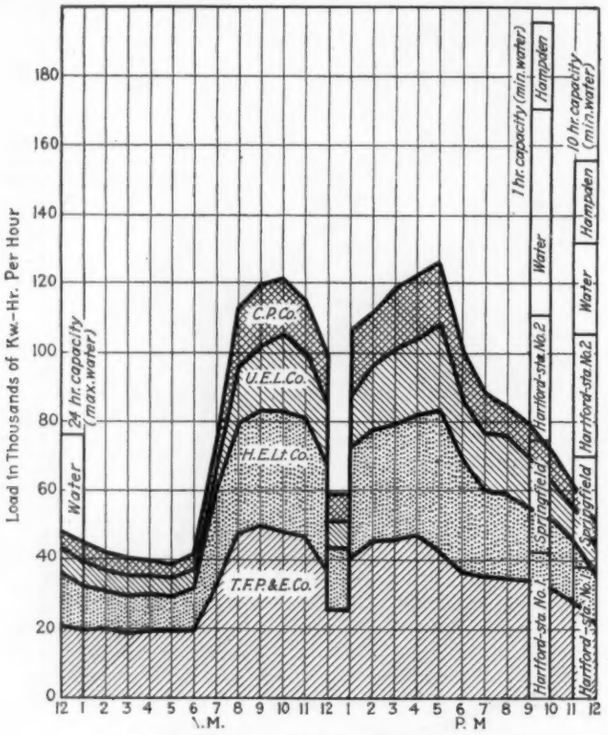
The Hartford company supplied electricity to about 50,000 customers within a territory having a population of close to 200,000. This company had two steam stations, each of 36,000-kw. capacity, supplemented by a

*Since this article was prepared the Central Hudson Gas & Electric Company, with 16,000 kw. in practical standby steam and 23,000 kw. in hydro-electric generating capacity, has joined the exchange, bringing the total existing steam capacity of the exchange to 231,800 kw. and the total hydro to 122,100 kw., or a grand total of combined steam and hydro of 353,900 kw.

10,000-kw. hydro-electric development owned by the Connecticut Power Company, a subsidiary. This hydro-electric station was located on the Housatonic River. The Hartford company's investment in plant was approximately $16,000,000, and its annual sales of electricity about 150,000,000 kw.-hr.

Basis of Operation

The interconnection plan contemplated the construction of a high-tension steel tower transmission line from one of the substations of the Turners Falls com-



COMPOSITE LOAD CURVE ON PEAK DAY, 1925

pany, located in West Springfield, to the South Meadow steam plant of the Hartford company, a distance of approximately 30 miles. As the Turners Falls and Springfield systems were already interconnected through the West Springfield substation, no new transmission lines between these two companies were needed. The estimated cost of the project was in the vicinity of $750,000. It was obvious that such an interconnection would effect a considerable saving in plant investment, inasmuch as it would postpone for several years the necessity for additional generating capacity. It was also evident that, in a system in which four steam stations of varying degrees of efficiency and two principal water powers, located on different rivers, were interconnected, economies of operation could be effected; it was, however, impossible to predetermine their extent or to fix in advance a fair price for which power should be bought and sold. Therefore the three companies proceeded upon the following declaration of principles:

1. That the first charge against savings to be effected should be a reasonable return on all new money spent by each company for the necessary connecting lines.

2. That each company should give or take power as the maximum efficiency of the whole system should demand at any given time.

3. That no company should benefit or suffer directly through the giving or receiving of power at any time, but that each was entitled to a share in the benefit accruing to all by reason of the interconnection.

4. That so long as each company maintained a plant capacity sufficient for its own load, plus 10 per cent, there should be no charges made for the use of one another's facilities, but whenever one company encroached upon this margin it should purchase spare capacity from the others at reasonable prices not to exceed the cost of its possible plant expansion.

5. That all savings above the fixed charges on transmission line investment should be pooled and equitably divided.

6. That the existing agreement between Turners Falls and Springfield, and the savings therefrom, be recognized and allowed for in the distribution of the exchange savings.

This was as far as it was feasible to go upon the basis of a general agreement, and all details of exchange and of operation were left to be determined by experience and mutual consent.

Organization of "Power Exchange"

The transmission line was completed and placed in operation early in 1925. In order that the system as a whole should be operated to obtain the maximum economy and reliability, a paper organization was set up, known as the "Connecticut Valley Power Exchange" and consisting of one representative of each company and a manager selected by them. Broadly speaking, it was the function of the exchange to buy and sell power from and to each company at each company's increment cost. On such a basis of price, no company profited or lost directly by any interchange of power, but the full spread remained in the exchange and represented the savings effected.

At any hour of the day the exchange purchased power from the company best able to furnish it—that is, at the minimum cost. The price paid for this power was the selling company's increment fuel cost; or, if an actual market existed outside of the exchange, the price was the price that could have been obtained in this market. The exchange then sold this power to one or both of the other companies, according to the maximum savings to be made, the sale price being the increment cost or saving of the purchasing company. In this way the spread between the cost of generation incurred at the then most efficient plant and the cost of generation saved at the then most inefficient plant remained in the exchange as savings. At the end of each month these savings were divided among the member companies.

Increment Costs

The exchange manager thus had the responsibility of making the best allocation of loads and determining the increment fuel costs incurred or saved in each transaction. Increment costs were figured from performance curves derived by plotting the fuel consumption of each station against its output. This average performance line was then used as a base against actual day-to-day performance. If, for example, Company A, with a steam station performance as represented by the line in the diagram, had a load on a certain day requiring an output of 300,000 kw.-hr. over the 24-hour period, and if it generated this output in its own station, the fuel consumption would have been 250 tons. Now suppose that Company B on the same day had available 200,000 kw.-hr. of surplus water power, that the ex-

change bought this block of power and sold it to Company A and that Company A was able to generate the remainder of its requirements, 100,000 kw.-hr., in its own station with an actual consumption of 120 tons of fuel. As the increment cost of surplus water was, of course, zero, the exchange profit was the full fuel saving effected by this transaction—in this instance, 130 tons of fuel. By applying the unit cost of fuel, this saving could easily be translated into dollars.

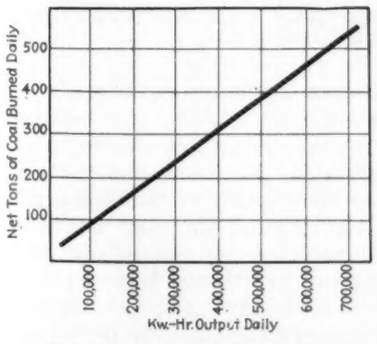
The price at which power was bought and sold fluctuated between wide limits, so that the daily transactions were often surprising. For example, a relatively few kilowatt-hours received by one plant might save the starting up of another boiler, in which case the saving in dollars might be relatively large, and, when divided by the small number of kilowatt-hours received, might result in a very high price per kilowatt-hour being paid by a highly efficient plant for power generated in an inherently less efficient plant. On one day, for example:

	Kw.-Hr.	Price Mills	
Hartford sold to the exchange	150,000	3.3	$490
Hartford bought from exchange	12,000	9.0	108
Springfield sold to exchange	38,000	5.2	195
Turners Falls bought from exchange	176,000	6.3	1,100
Exchange saving			$523

In this instance Hartford delivered to the exchange during the night 150,000 kw.-hr. which it produced at an increment fuel cost of $490, or 3.3 mills per kilowatt-hour. During the day Hartford took from the exchange 12,000 kw.-hr., to produce which, in its own plant, would have cost $108 in fuel, or 9 mills per kilowatt-hour. The total saving accruing to the exchange was the spread between the increment cost incurred and the increment cost saved in the day's transactions.

The exchange manager rendered daily statements to each station operator showing the result in dollars saved. At the end of each month the total savings were divided among the three companies by means of a process of intercompany billing.

Every effort was made to operate the system for the good of the whole, without regard to the effect on the cost of any one individual plant. Stations were operated and loads were allocated just as they would have been if the three companies were commonly owned or were integral parts of one great company. Surplus water power was, of course, used to the greatest possible extent. Under such an arrangement even the smallest economies were effected, whereas if there had been an agreed average price among the companies, either with or without profit, there would have been an exchange only when of advantage to both the receiving company and the supply company; and as the degree that fuel could be saved varied from hour to hour and from plant to plant, the maximum saving could not have been produced with an average price, fixed in advance.

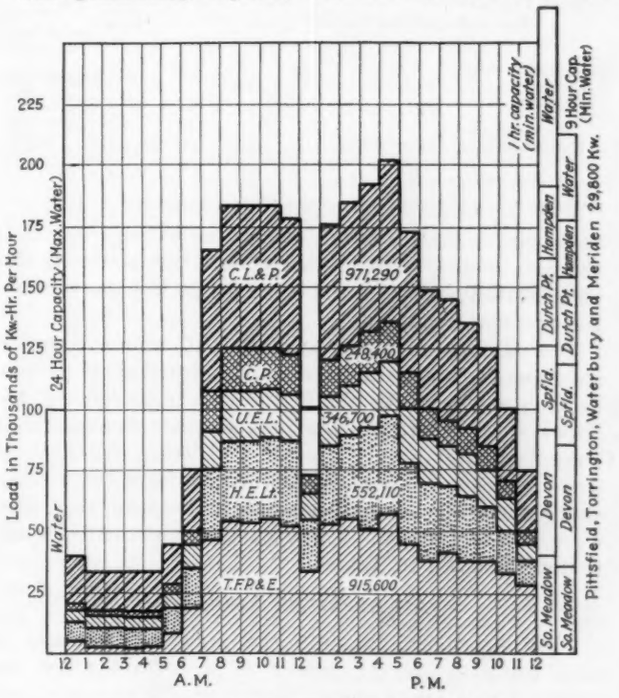


TYPICAL STEAM-PLANT PERFORMANCE CURVE

The results attained by reason of the interconnection and the interchange of power were most satisfactory to the participating companies. Each company benefited in three ways:

1. Saving in investment, through release of spare generating capacity.
2. Increased reliability of supply.
3. Operating economies.

The generating capacity released by reason of the interconnection was approximately 30,000 kw. With the systems connected together there was no need of additional generating capacity, since the combined relayed capacity*, even at low-water periods, exceeded the combined load by more than 300,000 kw. In fact it was possible to close down completely the steam station of the Turners Falls company for more than a year and one of the steam stations of the Hartford company for the greater part of a year; their loads were carried on the other more efficient stations. Thus for an investment of $750,000 in interconnecting transmission lines the three companies obtained additional generating capacity which otherwise would have cost, on the basis of $100 a kilowatt, at least $3,000,000. Fixed charges on this saving in investment would have been at least 10 per cent, hence the net saving to the three companies on an annual basis was not less than $225,000.



COMPOSITE LOAD CURVE ON PEAK DAY, 1926

The improvement in reliability of supply, although impossible to measure in dollars, was nevertheless an important result of the interconnection. During the first year of operation there occurred eleven major accidents at one or other of the nine stations connected to the system, each one of sufficient seriousness to have interrupted local service if that plant had not been connected to other sources of power supply. None of

*The relayed capacity of a station or group of stations is the capacity of that station or group with the largest single generating unit out of service.

TABLE I—CONNECTICUT VALLEY POWER EXCHANGE STATEMENT FOR TEN M N HS' OPERATION IN 1925

		Price, Mills	
Exchange Income			
For	31,277,900 kw.-hr. to Hart-ord	4.69	$146,749.54
	31,295,000 kw.-hr. to Springfield	5.40	169,045.59
	11,721,300 kw.-hr. to Turners Falls	7.98	93,562.84
Total	74,294,200		$409,357.97
Exchange Expenses			
For	8,556,000 kw.-hr. from Hartford	4.55	$38,989.97
	5,381,000 kw.-hr. from Springfield	4.93	26,551.45
	65,755,540 kw.-hr. from Turners Falls	2.31	151,867.47
Total	79,692,540		
	Exchange operating expenses		7,127.03
			$224,535.92
Exchange Savings			
	Income		$409,357.97
	Expenses		224,535.92
	Total savings		$184,822.05
	Fixed charges on line investment		74,000.00
	Net savings		$110,822.05

these accidents, however, caused any interruption to service, as the spare capacity in other power centers automatically supplied the shortage in the one in which the accident occurred.

The maximum use of water that would otherwise have gone to waste and the hourly distribution of loads in such a way as to obtain the greatest economy produced very substantial savings in the production expenses of the three companies. During the first ten months of operation the combined savings, before fixed charges on the new investment in transmission lines, were about $185,000. The exchange statement for this period is shown in Table I.

An Apparent Anomaly

This statement presents the apparent anomaly of each company buying power at a certain price and selling it at a lower price. Hartford, for example, paid on the average 4.69 mills for the power it took from the exchange and received 4.55 mills for the power it sold the exchange. This inconsistency is explained by the fact that the value of a kilowatt-hour in any exchange transaction was its increment cost, for the most part; the increment cost of producing a kilowatt-hour at night, for instance, was quite different than that obtaining by day. Thus Hartford lost nothing by paying a high price per unit of energy purchased at one time and receiving a low price for that sold at another time. The slightly lower figures at which Hartford, compared with the figures at Springfield, could both buy and sell power reflect the higher fuel efficiencies of the former's stations.

The savings obtained during 1926 include the Connecticut Light & Power Company as an additional partner in the exchange, and are tabulated in Table II.

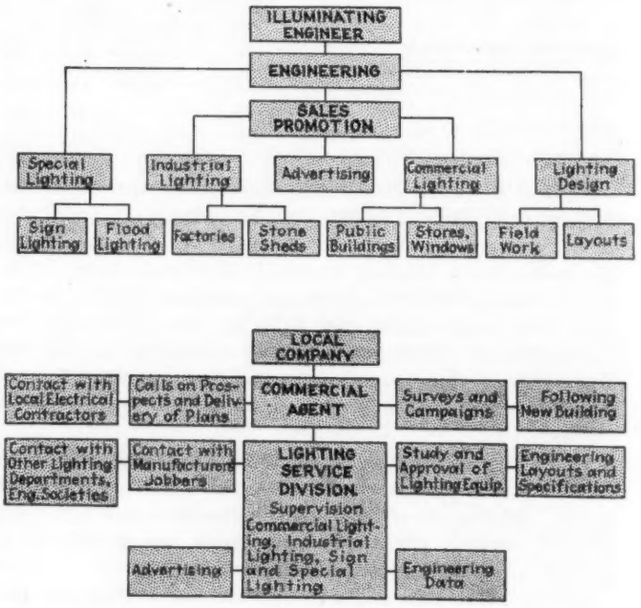
The combined savings for the 22-month period were $221,380.72. Although the loads of each company continued to grow rapidly during 1925 and 1926, each had sufficient capacity to meet the stipulated requirement of a 10 per cent reserve, so that it was not necessary for any one company to purchase spare capacity of the others.

TABLE II—POWER EXCHANGE STATEMENT FOR 1926

		Price, Mills	
Income			
For	36,323,800 kw.-hr. delivered to Hartford	4.97	$180,556.20
	29,189,000 kw.-hr. delivered to Springfield	5.33	155,611.39
	46,471,000 kw.-hr. delivered to Turners Falls	6.61	307,291.65
	4,314,800 kw.-hr. delivered to Conn. Lt. & Pwr.	3.87	16,707.36
Total			$660,166.60
Expenses			
For	28,875,000 kw.-hr. from Hartford	4.08	$117,924.10
	17,090,000 kw.-hr. from Springfield	5.61	95,873.16
	54,844,000 kw.-hr. from Turners Falls	2.64	144,917.35
	22,055,600 kw.-hr. from Connecticut Light & Pwr.	4.13	90,999.92
Operating expenses advanced by Hartford		....	8,868.42
Operating expenses advanced by Springfield		....	2,024.98
Total			$460,607.93
	Income	$660,166.60	
	Expenses	460,607.93	
Total savings		$199,558.67	
Fixed charges		$89,000.00	
Net savings		$110,558.67	

Co-ordinating Lighting Service on Local Properties

THE accompanying charts illustrate the relations between the lighting service division of a well-known management company and the lighting service activities of its subsidiaries. The first chart shows the service



HOLDING COMPANY AND LOCAL UTILITY ORGANIZATIONS FOR LIGHTING SERVICE

organization of the holding company's lighting division, built up on a basis of work subdivision. The headquarters staff consists of five inside and five outside men responsible to the illuminating engineer, and the chart shows the duties of the division rather than the organization of personnel. At present the staff duties per individual are varied and are not specialized, as in some large single-company practices. Men are transferred from one activity to another as occasion requires and the set-up is flexible and clean cut. The second chart shows the local company organization in relation to headquarters.

In general the solicitation of local business, survey work, etc., are handled directly by the commercial staff of the local company, the engineering responsibility, selection of equipment, purchasing, advertising and final control of the situation residing with the headquarters organization, which acts as expert adviser and court of last resort in the development of this class of business.

Cost of Off-Peak Business

Effect of Shifting Peaks—Utility Should Control Use of Capacity for Off-Peak Customers —Their Liability Should Be Limited to Actual Use of Available Plant Capacity— Advisability of Special Rates to Develop Business

By H. W. Hills

The Philadelphia Electric Company, Philadelphia, Pa.

EVER since the start of the business, the central-station industry has striven constantly to build up its load in such a way that its load factor would be improved. Many companies have lower rates for off-peak loads, and many other companies recognize the need for a good off-peak rate but are not sure just how much discount should be allowed to an off-peak user. Then there is always the possibility of conditions changing so that the customer who was once considered as being off-peak suddenly becomes a peak consumer. This latter consideration is of such importance that it has led to the modification of the peak responsibility theory and other developed theories used in the allocation of costs.

Almost all operating companies are now keeping their cost figures in such a way that they can show the actual cost of generating and delivering kilowatt-hours to a very high degree of accuracy as far as the variable portions of the costs are concerned. There is still considerable uncertainty and inaccuracy, however, in regard to those costs that are not variable with the quantity of kilowatt-hours generated. Consequently, so-called off-peak rates have been put into effect which charged the customer very little more than the actual variable generating cost. He was charged little or nothing for the use of the generating and transmitting equipment required to serve him, on the theory that, being an off-peak customer, anything received from him above the additional costs incurred by generating kilowatt-hours was just so much "gravy." On hydro-electric systems the "fixed" costs constitute the major portion of the total costs; hence low rates have been put into effect covering only the variable costs. With changing conditions, these so-called off-peak users came on the peak, and because the company had not been charging enough for the use of its equipment plus the variable expenses, disagreeable and expensive rate cases and readjustments resulted.

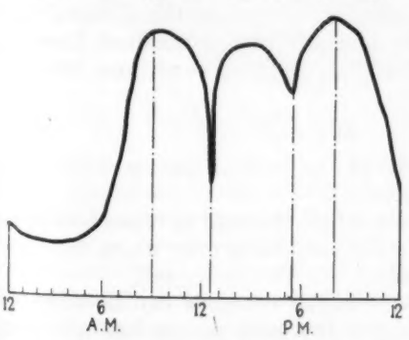


FIG. 1—POWER AND LIGHT CUSTOMERS HAVE DISTINCTIVE PEAKS

Perhaps the first factors to be considered in this problem of correct rates for off-peak customers is a determination of those characteristics that justify the central station in giving them these special rates. Let us consider some practical cases for the sake of clearness.

In Fig. 1 we have a daily load curve composed of two classes of customers—power and light. It so happens that in the case of this company the power and lighting loads do not overlap so as to cause a peak, but each has a distinctive peak of its own. Let us suppose that up to the present time the lighting load has been larger than the power load, with the result that the evening peak has always been larger than the morning or the afternoon peak. Many engineers have said that this power load, being off-peak, deserves special concessions and that as long as it pays for the additional expenses in fuel, supplies, wages, etc., incurred by the actual generation of kilowatt-hours it is a profitable load. Such is not the case. It is entirely unfair to the lighting consumer to force him to pay investment and other fixed charges for 24 hours a day for plant capacity that is used by other customers. These other customers should at least pay for their share of these investments and other fixed costs in proportion to the time and amount of equipment used. Interest charges are computed as some percentage per period of time, and likewise with all factors that go to make up fixed costs.

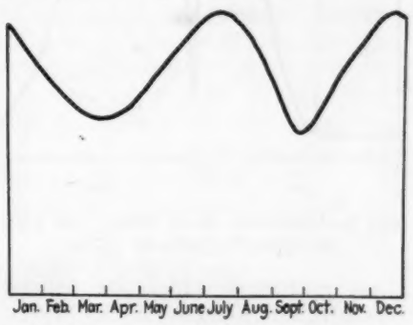


FIG. 2—EFFECT OF A LARGE OFF-PEAK CUSTOMER

The length of time the capacity is made available is a primary consideration in cost. So in this case there is a certain cost per unit of time incurred because equipment is made available for use. If the power customers do not pay for it, they are not paying enough to cover the costs of service and the difference is being made up by the lighting consumer.

In Fig. 2 we have an annual load curve with a high irrigation pumping load in summer and a high lighting load in winter. The possibility of the two ever overlapping is very remote, from the very nature of their characteristics. Now, which is the peak and which is the off-peak? With the peak in July equaling the one in December, it is evident that neither is off-peak. Let us suppose that the July load grows so fast that it becomes larger than the December peak, are we then going to say that the December load is off peak?

Should the December customers be relieved of the burden of paying for the fixed costs just because the July customers have a larger load on the system? The answer is obviously "No." The size of the peak should not be the determining factor in allocating cost between customers.

Now the question presents itself as to just what responsibility is thrust upon the central station supplying these customers. The most important factor of all is the fact that they must be supplied at the time they may demand current. This irrigation load in July must be supplied at that time. It cannot be supplied at any other time of year, and enough equipment must be made available to supply the maximum demand that may occur. Likewise with the lighting peak; equipment must be available at the time of this peak load to supply it. The responsibility of the central station is the same to each of these customers, and for any one customer it is absolutely independent of what the other customers may or may not do. Any savings that may accrue due to diversity of these customers cannot be attributed wholly to any one without injustice to the others. Such benefit is a result of circumstance rather than consideration on the part of either. Consequently any carrying charges must be apportioned among them in the same manner.

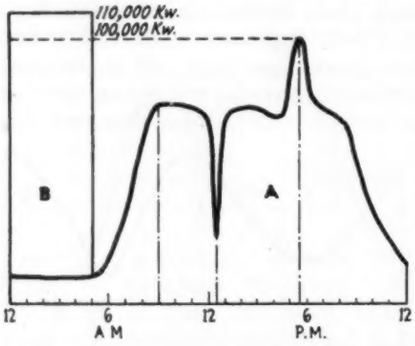


FIG. 3—SEASONAL PEAK EFFECT OF TWO DIFFERENT KINDS OF LOADS

From the foregoing paragraphs it is apparent that there must be something else peculiar to an off-peak customer in order to allow him any special consideration in the allocation of costs. I think the following special case will bring out the facts:

We have in Fig. 3 a typical daily load curve in December of a central station supplying light and power to a large industrial city. Let us suppose as a hypothesis that Customer B comes on "off peak," but he so changes the curve that the peak was moved from 100,000 kw. at 5:30 p.m. to 110,000 kw. from 12 to 5 a.m. Are we going so to change our cost allocation that the major portion of the fixed charges are now thrown upon Customer B? There must be certain limitations and definitions reached first before any correct allocation can be made.

First, it must be recognized that equipment of 90,000 kw. capacity was available for use during the hours shown on the curve. This equipment was necessitated by the customers who make up the curve under *A*. Their status is not changed one particle by the addition of Customer B, for they must still be supplied as usual regardless of whether B comes on the system or not. Customer B needs 100,000 kw. for five hours; but he has been acquainted with the fact that with the load curve *A* there is certain idle capacity available for use, and he is willing to adjust his demand in such a manner as the central-station company may dictate so that it does not interfere with the use of the generating plant for supplying the loads of the customers that make up curve *A*.

We now see that the status of Customer B is quite different from the status of the customers constituting *A*. In consideration of the fact that he regulates his load in the above manner, certain concessions apply to him which do not apply to the customers making up curve *A*. Just what is a fair allocation of costs?

Let us assume that the company has cost figures regarding the variable kilowatt-hour items, such as fuel, labor, etc., which are accurate to a fair degree. The remaining problem then is a determination of a fair and just allocation of fixed costs. If Customer B comes on the system between 12 midnight and 5 a.m. in order to use equipment that would otherwise be idle, it is fair to charge him for the length of time he uses this equipment and no more. Thus he uses 90,000 kw. for five hours, and therefore 5/24 x 90,000, or 18,750 kw., should be allocated to him. The remaining 10,000 kw. he demands in excess of capacity made available by other customers will have to be allocated as though it came on at the time of the station peak at 5:30 p.m., making a maximum allocation of 28,750 kw. for the use of 100,000 kw. for five hours.*

This case brings out the one fundamental factor that goes to make a real off-peak customer—namely, the central station can regulate the time of use of its capacity. If Customer B had been in such a position that the additional 10,000 kw. he needed over the 90,000 available could have been supplied at some other time, then this additional capacity would not have been necessitated and the cost allocation would have been for five hours' use of the 10,000 kw. instead of 24.

A central station need never worry about having too many real off-peak customers. The ideal situation would be for all customers to be off-peak. With this condition each customer would guarantee by suitable contract that his load could be supplied at the times specified by the company. Consequently there would be no peak, for the system would be constructed and operated in the most efficient and economical manner.

In developing a new class of business it is often necessary to serve this class below its fair share of cost until it is large enough to take care of itself. This case is similar to any "infant industry" that later becomes self-supporting. While developing this load, the business and operating conditions of the company are in a transient state, and any results obtained from an analysis made under the foregoing conditions must be viewed in this light.

SUMMARY

The responsibility of the central station differs for two classes of service:

1. Those customers whose demand is dependent upon weather, social or other conditions over which the company has no control.

2. Those customers whose demands can be adjusted by the company to give the most economical operating conditions.

The liability of all customers in the first class should be the same per kilowatt of maximum demand on the central station, regardless of whether they happen to come on at the time of the system peak or not.

The liability of all customers in the second class should be limited to the actual use made of available plant capacity, with suitable contract defining the minimum and maximum loads and conditions of service.

*For allocation of demands to customers constituting Curve *A*, see "Demand Costs and Their Allocation," ELECTRICAL WORLD, Jan. 29, 1927, page 249.

Arc Welding Eliminates Castings

in A.-C. Machines

Designers Are Endeavoring to Eliminate Castings Wherever Possible in Alternating-Current Generators and Motors and to Substitute Rolled-Steel Plate and Structural Steel Fabricated by Arc Welding or Bolting

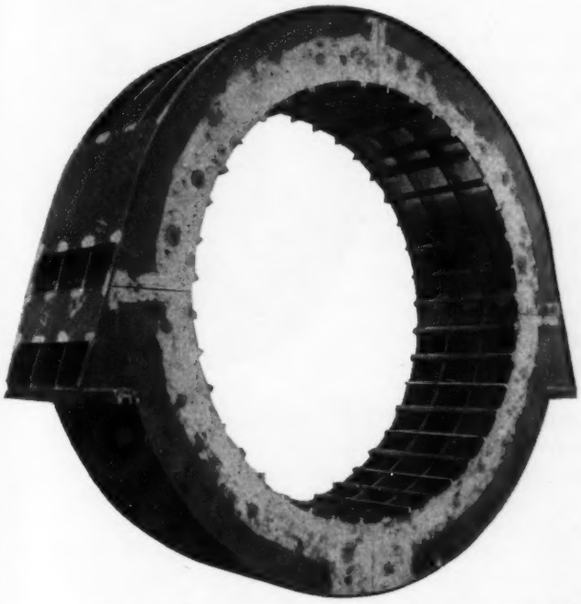
By E. S. Henningsen and A. P. Wood

Alternating Current Engineering Department, General Electric Company

SINCE the beginning of the electrical industry, stator frames of practically all alternating-current motors and generators have been cast structures of either iron or steel. For some years, however, the General Electric Company has very generally adopted a welded steel-plate frame construction for practically all types of alternating-current machines, both horizontal and vertical. There are a number of reasons for the use of steel plate and welding rather than castings. The cost of patterns and cores, the expense of storing patterns, the loss occasioned by defects in casting and the danger of failure in service because of internal strains, blow holes, etc., have always been appreciated by designers but have been tolerated because they were not sure that some other form of construction would not bring forth more serious troubles than the difficulties with castings with which they were so familiar from years of experience.

However, with the development of flame cutting of steel plate and the increase in knowledge of the art of welding and its wide adoption for all sorts of construction, designers have become convinced that a welded steel-plate construction will give a very much better mechanical structure and eliminate the difficulties incident to castings. Factory tests on a welded-plate design of a 1,400-kva. motor and subsequent frames demonstrated that this new type of frame eliminates the disadvantages of castings mentioned and gives a structure that is superior to the casting in strength and reliability and one that is much more able safely to withstand shocks incident to handling in manufacture and erecting or occasioned by short circuits.

The welded-plate stator construction as applied to horizontal and vertical units is illustrated in Figs. 1 and 2 respectively. The side plates of the horizontal unit consist of segments flame cut from heavy rolled plate and arc welded together by the hydrogen-enveloped arc. The use of the hydrogen-enveloped arc-welding process eliminates the necessity of scarfing the joints between segments and insures a ductile weld that will not break if the plates should be accidentally strained by being dropped or bent in handling. The supporting feet of the frame are cut out as part of the side plates and arc welded to a heavy plate, which is drilled for the holding down and adjusting bolts. The back plates are also flame cut and are then formed by rolling to the proper diameter and welded to the side plates by an automatic arc-welding machine, which insures a perfect job of welding.



FIGS. 1 AND 2—WELDED STEEL-PLATE STATOR FRAMES FOR 20,000-KVA. HORIZONTAL AND 10,700-KVA. VERTICAL WATERWHEEL-DRIVEN GENERATORS

On the inner periphery of the side plates are welded

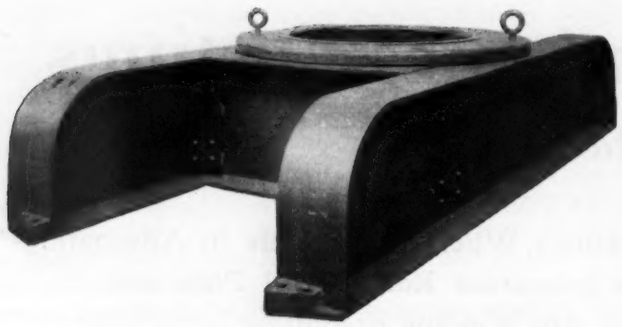


FIG. 3—STRUCTURAL STEEL UPPER BEARING BRACKET DESIGNED TO CARRY A LOAD OF 120,000 LB.

steel bars, which support the keys on which the stator laminations are stacked. The frame illustrated is split on the horizontal center line because of shipping requirements, the two halves being held together by bolts passing through blocks welded to the side plates. Ventilating air openings are provided in the back plates, which are later covered by punched or expanded metal screens.

The construction of the stator of the vertical unit is similar to that used for the horizontal machines except that the bottom side plate is extended to permit fastening to the foundation and a heavy rolled ring is welded to the top of the side plate to support the upper bearing bracket. Six openings in the wrapper plates are left for the discharge of ventilating air, which in the case of this particular machine passes out directly into the station.

FABRICATED-STEEL ROTOR SPIDERS

The disadvantages of castings become still more important where rotating elements are considered, especially those that are subjected to high stresses such as rotors of waterwheel-driven generators which have to be capable of withstanding overspeed of 80 to 150 per cent above normal. New developments in rotating elements have been along three general lines:

1. A large number of smaller rotor spiders have been built of welded steel plate (Fig. 5). The hub is flame cut from thick steel plate or made from shafting stock, to which is welded a center web, also flame cut out of heavy rolled plate. The rotor rim is steel plate rolled to the proper diameter and welded to the center web. This outside rim may be either a single plate with an arc-welded butt joint or, as illustrated, made of two rolled plates having the joints staggered and welded together completely around the outer edges. Since the rim plate is welded to both sides of the web plate around the complete periphery, the welded joint of the rim does not have to take the entire load of the centrifugal force of the poles.

2. Another design of rotor spider that eliminates castings is the laminated punched type. The new development in this construction is the extension of this form to spiders up to about 10 ft. in diameter, whereas the previous limit was about one-half this size. In the rotor spider shown in Fig. 6 the shaft hole, ventilating openings and dovetail slots for securing the pole pieces are all punched out on a punch press. This form of spider is usually built up in sections, the laminations for each section being held together by through bolts. Such a construction makes an excellent mechanical design, since the complete spider is made of a material the mechanical properties of which can be accurately determined in advance. This type of spider design has been used on machines from 5 kva. to and including a 100,000-kva. machine.

3. The third general type of rotor spider is an entirely new development. It consists of a free rim made of segmental punched laminations mounted on a centering spider, which may be either a fabricated structure or a casting. The laminated rim is not anchored to the centering spider and hence carries all of the centrifugal force of the poles. Since the center has to support only the weight of the rim and poles and transmit the torque from the shaft, it is not so serious to make this part of the structure of cast material. However, a number of machines have already been built with fabricated centers and it is expected that few cast centers will be used in the future. A welded steel plate centering spider ready for the assembly of the laminated steel plate rim is shown in Fig. 7. The segmental bolted plates on the end serve as a support for the weight of the rim and poles and also as a braking plate. The individual laminations are held by through bolts in reamed holes, and the bolts are so designed for shear and crushing that the rim develops the full strength of the plates. The numerous square punched holes around the periphery are for the insertion of coil springs, which support the field coils and keep them tight against any possibility of shrinkage of insulation.

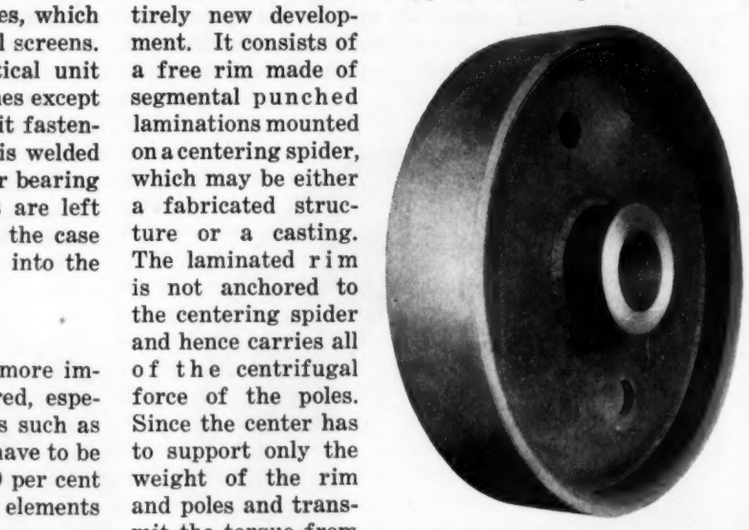


FIG. 5—ROTOR SPIDER MADE ENTIRELY OF WELDED STEEL PLATE

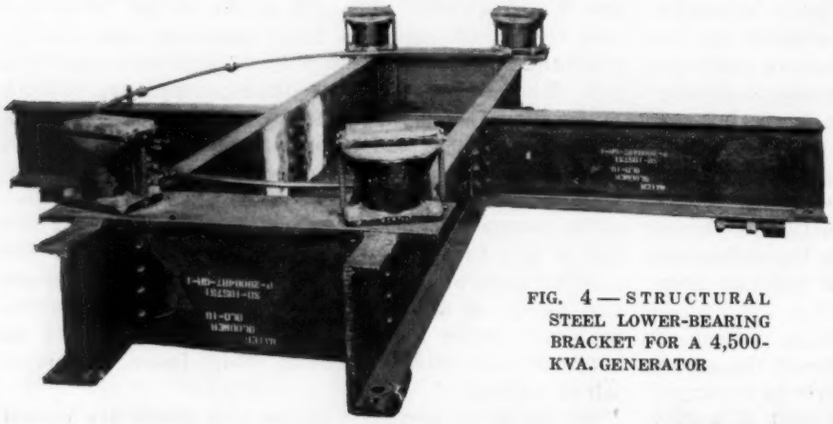


FIG. 4—STRUCTURAL STEEL LOWER-BEARING BRACKET FOR A 4,500-KVA. GENERATOR

The segmental laminated free-rim type of rotor spider has been used in the construction of 28 vertical waterwheel generators, and both factory tests and operating experience prove this design to be a most satisfactory answer to the problem of how to

build large-diameter rotors without the use of castings.

The first application of fabricated structural steel for lower guide-bearing brackets was made on the 20,000-kva. generators of the Alabama Power Company, which were designed in 1921. Since that time practically all of the large diameter vertical waterwheel-driven generators have been furnished with structural steel lower brackets and lately the fabricated type of construction has been quite extensively employed in the design of the upper-bearing brackets. The structural steel lower guide-bearing bracket for a small vertical generator shown in Fig. 4 is made from standard channel sections bolted together. The plates supporting the combined brakes and jacks are arc welded to the channels. For the larger machines standard I-beams and girder beams are fabricated, usually by a combination of welding and bolting.

A typical upper bearing bracket which carries the thrust bearing and upper guide bearing is illustrated in Fig. 8. Standard rolled girder beams are employed in this design and the appearance is improved by cutting off the ends of the beams to an arc of a circle and welding on a rolled plate. When the load and span are such that the largest size of rolled beams (Fig. 3) are not strong enough, steel shapes are built up by welding. A bracket for a 19,000-kva. generator is practically completed at the present time, which is made entirely of steel plate arc welded to form sections strong enough for the load of 700,000 lb. which the thrust bearing has to carry.

Welded structural steel shapes have been extensively employed as a substitute for castings for bases and foundation plates. The standard Z-shapes, channels, girder and H-beams lend themselves particularly well to the fabrication of bases for individual machines and for motor-generator and frequency-converter sets.

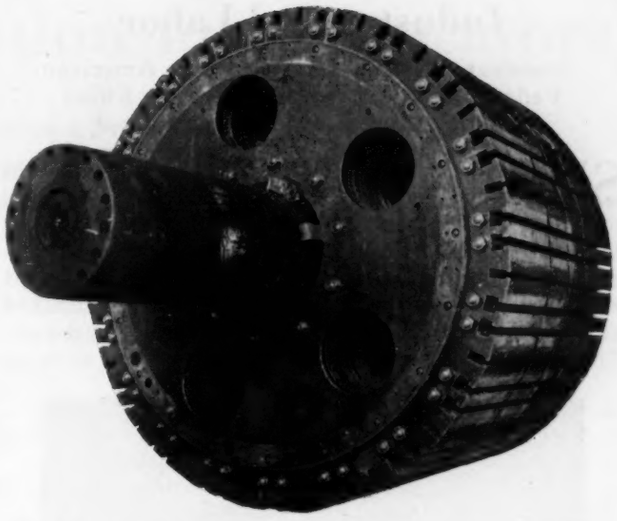
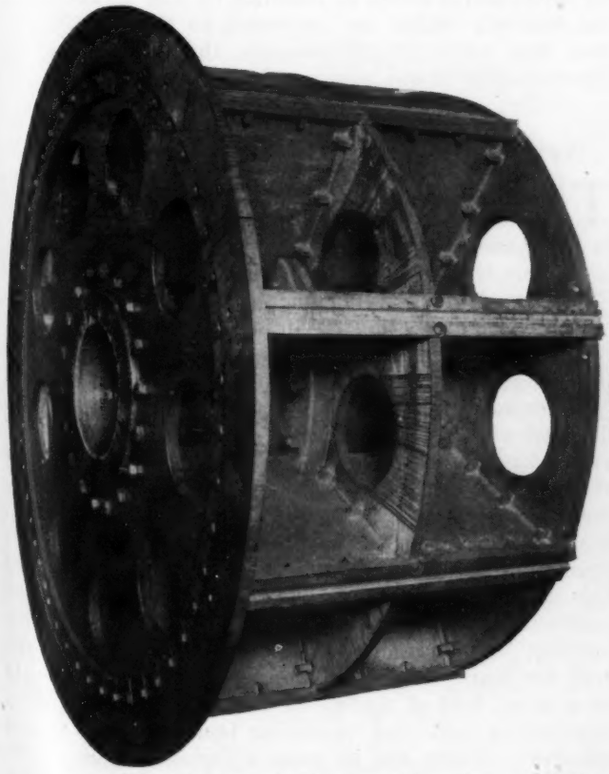


FIG. 6—ROTOR SPIDER (102 IN. DIAMETER) MADE FROM SOLID PUNCHED LAMINATIONS FOR A 33,000-KVA. WATERWHEEL-DRIVEN GENERATOR
(The shaft shown is simply a lifting bar)

Only the major items of change in motor and generator design that have been recently put into effect have been cited. However, they are enough to show that the design and manufacture of alternating-current machines are being revolutionized to take advantage of the developments that have been made in fabricating and welding of rolled steel. The punch press, the bending rolls and the automatic welding machines are replacing the foundry and the large machine tools that have always been necessary in the past. The day is here when huge generators can be made lighter and yet stronger mechanically by the complete elimination of castings.

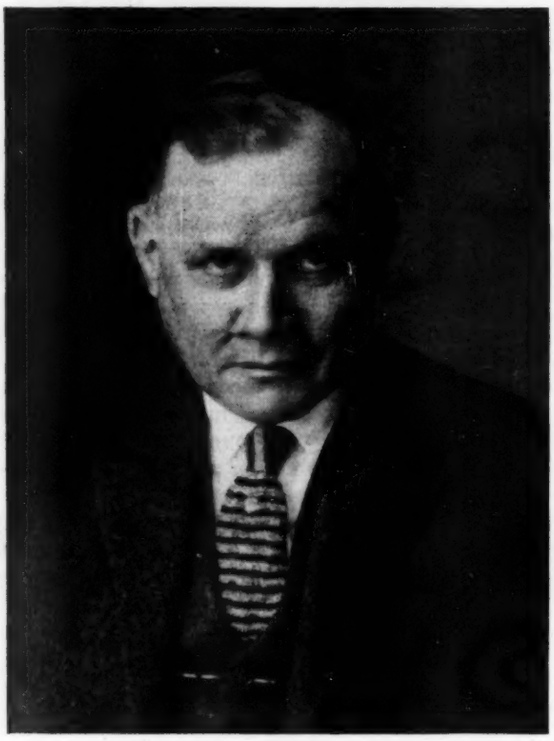


FIGS. 7 AND 8—WELDED STEEL-PLATE CENTERING SPIDER OF 20,000-KVA. GENERATOR BEFORE AND AFTER ASSEMBLY OF LAMINATED RIM

Industry and Labor

President William Green of the American Federation Speaks for Co-operative Effort and Mutual Understanding

SPEAKING on "The Relation of the Electric Light and Power Industry to Labor," William Green, president of the American Federation of Labor, said at the National Electric Light Association convention recently that it is in the field of industry and labor that electric light and power has made its most marked advances and extended its service to the greatest degree. The lives and welfare of the great mass of working



W. H. GREEN

people associated with industry, he declared, have been vitally affected through the introduction and use of electricity in industry. There is a very close relationship between the electric light and power industry and labor. It is a relationship which affects wages, productivity and efficiency. Labor is thoroughly conscious of the active and potential possibilities in the great domain of industry and industrial expansion.

"The advent of electric power," Mr. Green said, "has increased the value of machinery manyfold, and the productivity and efficiency of the individual worker have increased in ratio to the increase in value. Electric power has proved to be a revolutionary factor because through its adaptability and its general use it has been proved that wages can be substantially increased while the cost of manufactured articles is materially reduced. The effect of this economic development is so far-reaching that it makes an appreciable difference in the real wage that the workers receive.

"The American worker," he went on, "is highly efficient. Electric power and machinery enable him to use that efficiency to its fullest capacity. An analysis of the industrial situation shows that electric power is the greatest contributing factor toward the increase in the efficiency and productivity of the working people of our country. While productive standards have been raised in every industry which has been electrified, the most notable increases in individual and industrial efficiency are shown in the automobile industry, shoe manufacturing, the textile industry, coal production and the printing industry. The output of these industries shows how the use of electric power has increased the volume of commodities produced and multiplied the producing capacity of the millions of workers employed.

"It is my opinion that co-operation, understanding and a spirit of mutual interest can be exemplified in the electric power industry to a degree as great as or greater than in any other industry. In the transportation lines, where electric power is being used more and more, and in public utility companies men and management come into close contact with each other and with the general public and the public interest. Many problems of public character arise which seriously affect the economic interests of all concerned and the social interests of the great mass of working people.

"The highest and best interests of all can be served through co-operation and understanding. I sincerely hope that the wage earners and the employers and management associated with the electric power industry will establish a happy reciprocal relationship based upon a recognition of their common interest and common welfare. Through the adoption of such a plan agencies can be established through which they may solve their economic and industrial problems and further the uninterrupted operation of their plants in the interest of the public good and the public welfare.

"American labor welcomes the extended use and development of electric power and electric service. We wish to be helpful in promoting the success of this great industry. Labor offers its service, its skill and its constructive effort in building up and in extending the industry which you represent so that the human race may enjoy in full measure the advantages and opportunities of our modern civilization."

Artificial Daylight Relieves Eye Strain

THOSE who experience eye strain after reading by unmodified artificial light may possibly find relief in using one of the so-called "artificial daylight" lamps, according to the Bureau of Standards of the United States Department of Commerce. Several reasons are cited for believing that daylight is superior in several respects to ordinary electric incandescent light as an illuminant for reading black print on white paper.

An experiment recently conducted shows that one individual who had experienced for many years not only great dissatisfaction and discomfort but also painful after effects, such as headache, in reading with ordinary incandescent lamps finds great satisfaction and the absence of disturbing after effects in reading with artificial daylight. The bureau's experiment was limited to this one case, but other cases are on record in which readers find benefit in substituting artificial daylight for ordinary illumination. If this should prove to be the case for many people, it is apparent that there would be a great field of usefulness for artificial daylight in eliminating pain, and increasing human happiness and efficiency. There will be great differences among individuals, but it will probably be worth while for those who suffer after evening reading to try the effect of artificial daylight, the bureau concludes.

High-Speed Excitation for Generators

Factors Taken Into Consideration in the Adoption of a High-Speed Excitation System for the Lock 18 Hydro-Electric Plant of the Alabama Power Company

By F. G. Hamner

Engineering Department, Alabama Power Company, Birmingham, Ala.

INTERCONNECTION MAP, SHOWING CONCENTRATION OF HYDRO POWER IN ALABAMA SYSTEM

UNUSUAL interest, caused by the fact that high-speed excitation will be used throughout, has been developed over the studies leading to a final decision on a particular design for the four generators that will be used in the Lock 18 plant of the Alabama Power Company. A purchase agreement has been entered into with the Westinghouse Electric & Manufacturing Company covering these units. The machines are rated at 29,000 kva. (25,000 kw. at 0.862 power factor), 12,000-Y volts, 1,400 amp., three-phase, 60 cycles and 100 r.p.m. Each generator will be direct connected to a 36,000-hp. vertical hydraulic turbine of the reaction type as manufactured by the S. Morgan Smith Company. The normal head on the waterwheels will be 90 ft., but the turbine will be so designed as to operate satisfactorily between heads of 93 ft. as a maximum and 65 ft. minimum.

The peculiarly vital location of the Lock 18 generating plant with reference to the system of the Alabama Power Company is such as to warrant unusual consideration being given to the generators for the plant. Reference to the accompanying map will indicate this position, in that Lock 18 will be one of a nest of six ultimate generating plants, all situated on the lower section of the Coosa and Tallapoosa rivers and all within a radius of 25 miles. Viewed as a whole, the picture represents a 110-kv. network fed mainly from a group of hydro plants so close together as to appear as one mammoth generating station. Although the practice of concentrating power plants in such a small area may on first thought appear unwise, reflection on the fact that hydro sites have been chosen for us by nature will justify in one's mind such a practice. These sites, being the most advantageous, have been developed as the system load growth called for such development.

Recently the Lock 18-Mobile line was completed, so that upon the Lock 18 generators fell the burden of charging and feeding the 227-mile line to Hattiesburg, Miss., and also the more recently built 240-mile line to Mobile. Although both of these lines are equipped with synchronous condensers for voltage regulation, the Lock 18 generators will have to be such as can charge either of the two lines with one machine without the machines becoming self-exciting beyond a stable point.

Until recently no great difficulties were experienced in operating the Coosa and Tallapoosa plants satisfactorily. With the coming of more extensive interconnection with the power companies of Georgia, the

demands for power on the Coosa River plants grew. When this demand increased to such a point as to require both the Gadsden-Lindale tie line and the North Auburn-Newnan line to be operated at their maximum capacity, the system had its first real introduction to the problem of stability. Any shock to the systems that served to trip out the Gadsden-Lindale tie line was accompanied by an interruption to the tie line out of North Auburn. Investigation of the nature or causes of such sympathetic interruptions led to the conclusion that as one of the tie lines opened the other immediately attempted to carry the load, which was considerably beyond the stability limitations of the line. On further analysis it was found that the limit of the lower line, North Auburn-Newnan, was approximately 45,000 kw. As there was a maximum demand from Georgia of 80,000 kw. over two lines, it was realized fully why the lower tie line always pulled out when the upper or Lindale line suffered an interruption.

Furthermore, a short circuit on any line between any of the four hydro plants in the district presented another problem in the form of a possible pulling out of two plants. If the fault were of short duration, the probability was that the system would ride through it successfully, whereas were the short to continue so that the voltage dropped to, or nearly to, zero, the chances were ripe for two of the heavily loaded generating stations to separate, with a subsequent interruption to service and a considerable shaking up of all synchronous apparatus.

This problem analyzed itself into one of stability, and it appeared wise to investigate further the causes of instability and the means at hand for correcting the accompanying evils. Other minor problems presented themselves, but were insignificant when compared with the main questions. There remained, then, three problems, and to help solve these the design of the Lock 18 generators was looked to. To summarize, these were:

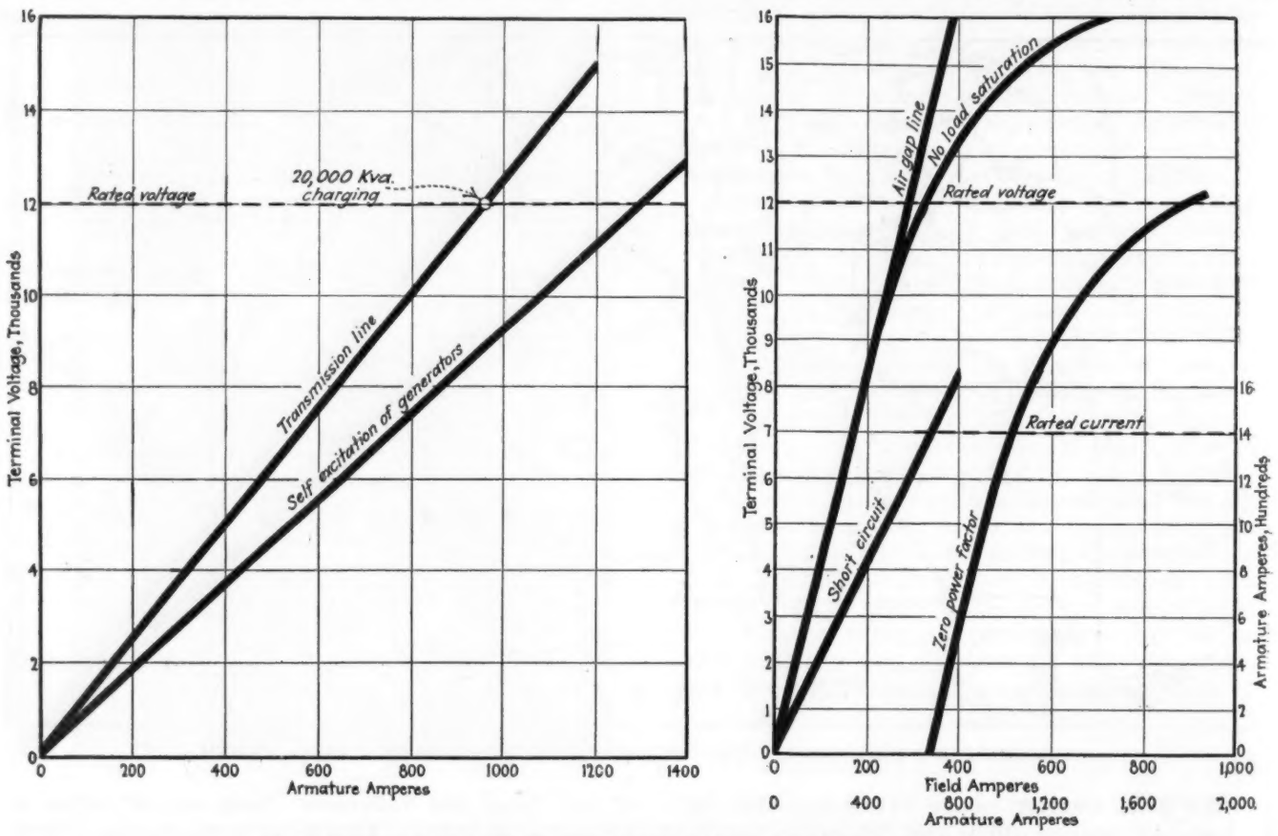
1. Charging characteristics of the long lines feeding from Lock 18.

2. Prevention of interruptions due to pulling out of generating plants upon occurrence of short circuits between them.

3. Improvement of stability on own system and on lines feeding into Georgia.

The first of these problems was readily solved by specifications covering the duty of the machines. Manufacturers' designs immediately included the proper characteristics leading to stable operation when charging the line. The characteristics of the machines and transmission line and the margin of safety obtained are shown in the two graphs herewith. Problem 2 presented complications of an intangible nature, and it was soon realized that its solution would follow closely that of Problem 3. Rapid response to a drop in voltage by the excitation system would probably do much to enable the system to ride through disturbances of such a nature, and as it was obvious that the whole question of stability was one of "excitation when needed," any features tending to improve conditions under Problem 3 would likewise help the situation covered by Problem 2.

As investigations developed it became evident that a complete study of the system involving such features as governor design and speed of operation, inertia of all moving elements, reactances of loops and networks, and voltage regulator settings was almost humanly impossible, or at best a laborious and complicated proc-



CHARACTERISTICS OF LOCK 18 GENERATORS HAVING HIGH-SPEED EXCITATION

ess. From such tedious calculation, full of necessary assumptions, could be squeezed but a small amount of worthy information. Although present knowledge of and means of handling the calculations pertaining to the subject of stability are directed toward the problem of one-way transmission of power with known conditions at each end of the line, the general conditions have been verified to such an extent by experience as to warrant carrying out these considerations even in a network such as that of the Alabama Power Company.

In the final analysis, a network is susceptible to the same laws and the behavior is fundamentally the same as in simple circuits. It being only in the degree of complexity and multiplicity of generators, lines and loads that they differ, engineers may, in working stability problems of a general nature in a complicated network, take as a criterion those self-same principles that are known to be of value in aiding simpler circuits. Realizing the importance of a quick response excitation system on generators as a means of improving stability and also realizing the advantage of having machines of high short-circuit ratio for the same purpose, it was deemed advisable to give further study to the design of the Lock 18 generators with a view of incorporating such features as would better the stability situation.

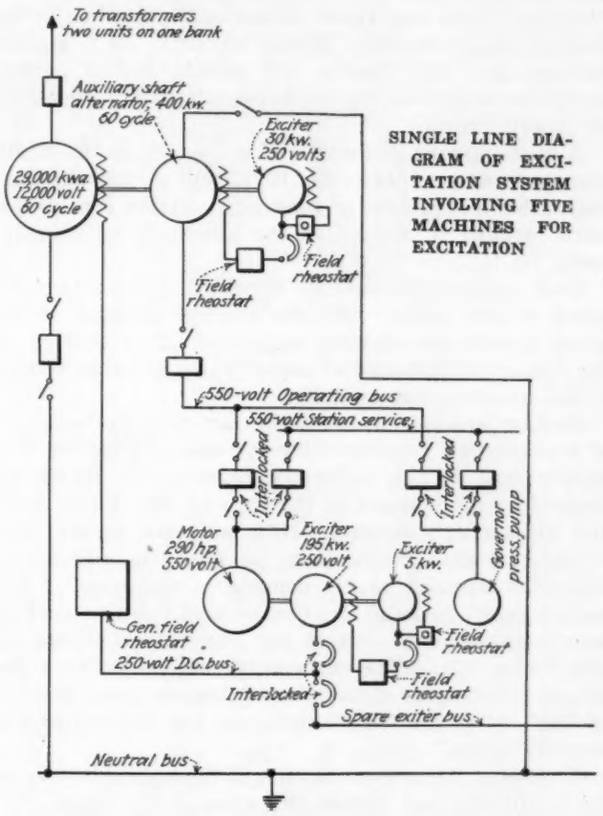
Indirect Benefits from High-Speed Excitation

It is from considerations of this nature that justification is found for the expenditure of extra money for high-speed excitation. Briefly, then, the reason for going to such a system of excitation is that it is a factor from which benefits will be obtained, although in itself it cannot be expected to stabilize the system completely. Recent calculations seem to indicate that an additional 7,000 kw. can be carried over the lower tie line to Georgia with quick response excitation.

A high short-circuit ratio machine is, in itself, an aid to system stability, yet detrimental to the proposition of keeping short-circuit currents as low as possible. Thus, a decision on what should be the short-circuit ratio of a generator must necessarily be a compromise between the two extremes. Short circuits can be reduced by the judicial use of reactors in the circuits and by the application of a carefully studied plan whereby the system is not tied together solidly. Either of these principles has a tendency to undermine the degree of stability which the system may have. A short-circuit ratio of 1 (normal design) was specified for the Lock 18 generators primarily because of the lower first cost, but also because of the lower short circuits that will be obtained. It was not felt, nor proved conclusively, that the benefits to be derived from a machine of higher short-circuit ratio would offset the initial cost. Moreover, the lower ratio machines will not demand the installation of bus and line reactors from which the stability characteristics of the system would suffer.

The quick response excitation as shown graphically in the diagram will be accomplished by mounting a 400-kw., 575-volt, 60-cycle, alternating-current generator on top of the main generator keyed to the shaft. The excitation for this machine will be furnished by a small direct-current generator mounted on the same vertical shaft directly above the auxiliary alternator. This latter machine is to have a rating of 30 kw., 250 volts, 100 r.p.m. The auxiliary generator will drive a 550-volt, three-phase, 60-cycle, 1,200-r.p.m. squirrel-cage induction motor, which in turn will drive a direct-connected 250-volt, 195-kw., direct-current generator, the output of which will be used to excite the main 12,000-volt generators. The field of this direct-current generator is divided into two parallel windings as an aid to the quick response principle. Excitation for this last direct-current generator will be supplied by another small 5-kw., 250-volt exciter mounted on the end of the same shaft. Thus there will be five machines forming the excitation system, whereas formerly only one was used.

Four rheostatic type automatic voltage regulators as



SINGLE LINE DIAGRAM OF EXCITATION SYSTEM INVOLVING FIVE MACHINES FOR EXCITATION

manufactured by the Westinghouse Electric & Manufacturing Company will be employed. These regulators, operating in connection with a positive phase sequence network, are looked upon to give positive regulation of such speed, when working with the excitation system outlined above, as to give an increase in exciter voltage at the rate of 600 volts per second between the limits of 100 and 150 volts.

British Revise Insulating Oil Specification

A SPECIFICATION just issued by the British Engineering Standards Association deals with insulating oils for electrical purposes, excluding cables. It is a revision of a specification issued in 1923, in which, as a result of experience, various amendments have been found desirable, chiefly with the object of increasing the available sources of supply of suitable oils. The classification of oil is based, as in the old specification, on the sludging properties of the oils, but Class C oil has been eliminated. Each class of oil is further subdivided, for classification purposes, into three grades, which are based on the "cold" test of the oils. The oils are no longer graded on the viscosity, one viscosity limit being now given for all classes.

Letters from Our Readers

Allocating Capacity Costs

To the Editor of the ELECTRICAL WORLD:

In regard to the article on "Excess Peak Responsibility Versus Demand in Cost Studies," in the ELECTRICAL WORLD of July 23, W. J. Greene is to be congratulated on his fine discussion of my paper on "Demand Costs and Their Allocation," published in the ELECTRICAL WORLD Jan. 22 and 29, 1927. It is at once obvious that Mr. Greene and myself are in perfect accord in regard to the fundamentals of the allocation of capacity costs.

A most cursory inspection of my article in the ELECTRICAL WORLD of Jan. 29, 1927, will reveal the fact that, after due process of reasoning, certain conclusions were reached in regard to the allocation of capacity costs, viz.:

Each customer should be allocated a capacity composed of two parts: (1) the average demand of his actual hours' use of plant capacity; (2) a portion of the "phantom customer's" capacity, or, in other words, of the unused plant capacity.

Further analysis deduced the fact that the measure of a customer's responsibility for unused capacity was proportional to the difference between his maximum demand or his demand at the time of the station peak and his average demand. Now we come to the crux of the problem: Which is to be used, the customer's maximum demand or his demand at the time of the station peak? Again Mr. Greene and I are in perfect accord, for on page 166 of the ELECTRICAL WORLD of July 23 he says: "The controversy will be between the use of the 'excess demand' and 'excess peak responsibility' ratios for the allocation of the 'unused period capacity' costs."

Obviously, the answer is that it depends solely upon the conditions, and I made this clear in my paper. On page 251, ELECTRICAL WORLD, Jan. 29, 1927, appears the following statement: "It may seem wrong to charge Customer H, who has a demand of 10,000 kw., for only 834, although he is entirely off-peak. But under the conditions this is fair and reasonable, for this demand is being used at such a time that no added cost is caused, and it is merely an allocation of existing costs so that he will be charged a fair amount for use of the equipment. If this demand should increase so that it might shift the peak on the station, then it will be necessary to include this customer in the allocation of the phantom customer's bill, and this can be accomplished quite easily by merely considering this customer as being on at the time of the station peak."

It goes without saying that this same statement applies to Customer D or any other. And, furthermore, it should be perfectly evident that the size of the demand is not the only thing to be considered. If conditions are liable to change so that a customer may come on the system at the time of the peak and must be supplied at that time, to him should be allocated a portion of the phantom's kilowatts.

The writer regrets that Mr. Greene failed to present a development of this method before the paper on "Demand Costs and Their Allocation" was submitted to the prize awards committee of the National Electric Light Association on April 8, 1926. On referring to the article entitled "Allocation of Electric Service Costs," by W. J. Greene, C. F. Schoonmaker and C. B. Gorton, in the ELECTRICAL WORLD of Oct. 28, 1922, page 928, it is at once evident that an arithmetical example was given which was one application of the phantom-customer method. However, no attempt was made to develop the principles of a theory which would apply in all cases, as does the phantom-customer method. It is with great gratification that the writer reads Mr. Greene's comments on the way this application has worked and that six years' experience has given satisfactory results within certain limitations.

Further analysis of the phantom-customer method will reveal the fact that if all customers are considered as being on at the time of the station peak, and the phantom's kilowatts are allocated between them in proportion to the excess of their maximum demands over the average, the method then becomes identical with Mr. Greene's method, published in the ELECTRICAL WORLD of May 29, 1926, under the heading "Allocation of Capacity Costs."

It should be quite obvious to any casual reader that the reason the writer did not refer to this article is because his paper was submitted to the prize awards committee on April 8, 1926, for the Doherty prize, which was awarded to him on May 18, 1926. If Mr. Greene's paper had been available to the writer, this contribution would certainly have received due recognition.

In conclusion, let me say that I again agree with Mr. Greene that the excess demand rather than the excess peak responsibility should be used for the majority of customers in the allocation of the phantom's kilowatts or unused capacity. It all depends upon the conditions, and the writer believes that no single method will ever be devised where results that are fair to all concerned will be obtained by neglecting the various factors which govern a customer's responsibility.

A correct application of the phantom-customer method will take care of a customer's responsibility in one or a combination of more than one of the following three ways:

1. His maximum demand is considered as coming on at the time of the station peak.
2. His demand at the time of the station peak is used in the computation of the allocation of the phantom's kilowatts.
3. His demand is entirely off-peak, in which case this maximum demand is not used and no portion of the phantom's kilowatts is allocated to him.

Philadelphia Electric Company,
Philadelphia, Pa.

H. W. HILLS.

Accuracy Attained in Billing New Jersey Utility Customers

The Public Service Electric & Gas Company of Newark, N. J., one of the largest public utility companies in the country, uses 4½ tons of paper each month for billing purposes. The company has more than 1,400,000 gas and electric meters in service, which are indexed and billed at the rate of 65,000 meters a day. The errors incurred by the billing department amount, it is claimed, only to the infinitesimal proportion of one-one-hundred-thousandth of 1 per cent. In other words, only one bill out of 10,000,000 is in error, so the chances of an individual customer getting the erroneous bill are almost non-existent.

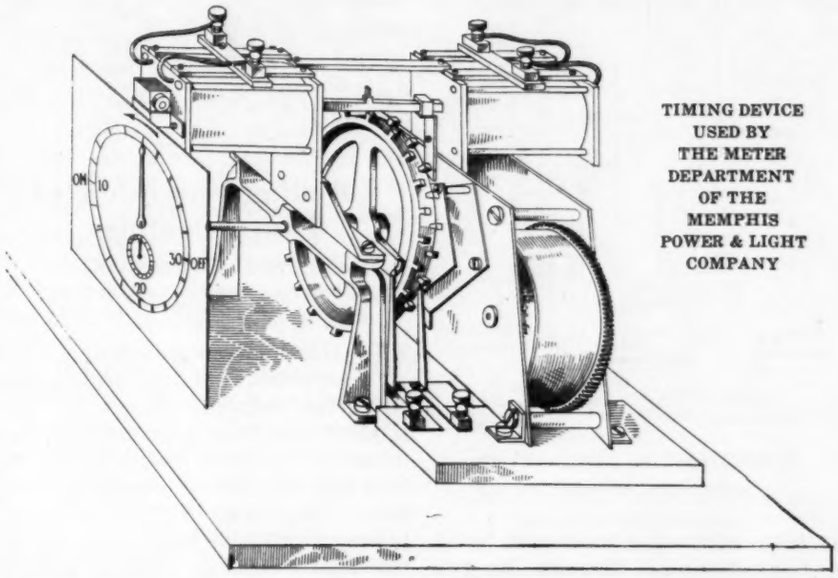
Central Station and Industrial Practice

Accurate Timing Device for Meter Test Work

By E. A. CORUM

Meter Superintendent Memphis (Tenn.) Power & Light Company

TO ELIMINATE the use of stop watches in making tests with laboratory indicating ammeters, voltmeters and wattmeters, the meter department of the Memphis Power & Light Company has constructed the timing device shown in the accompanying illustrations. The apparatus consists of a Westinghouse 35-day hand-wound clock with part of the gear reduction removed so that with one winding nine hours' continuous running can be obtained. Two specially wound coils of No. 29 cotton-covered copper wire 2½ in. long and 1¾ in. diameter, each with a ¾-in. square laminated core in the shape of a U, are used. One leg of this core, 1½ in. long, fits into the coil and the other leg, 2 in. long, tends to complete the magnetic circuit through a ¾-in. soft iron plunger that operates back and forth from one coil to the other.

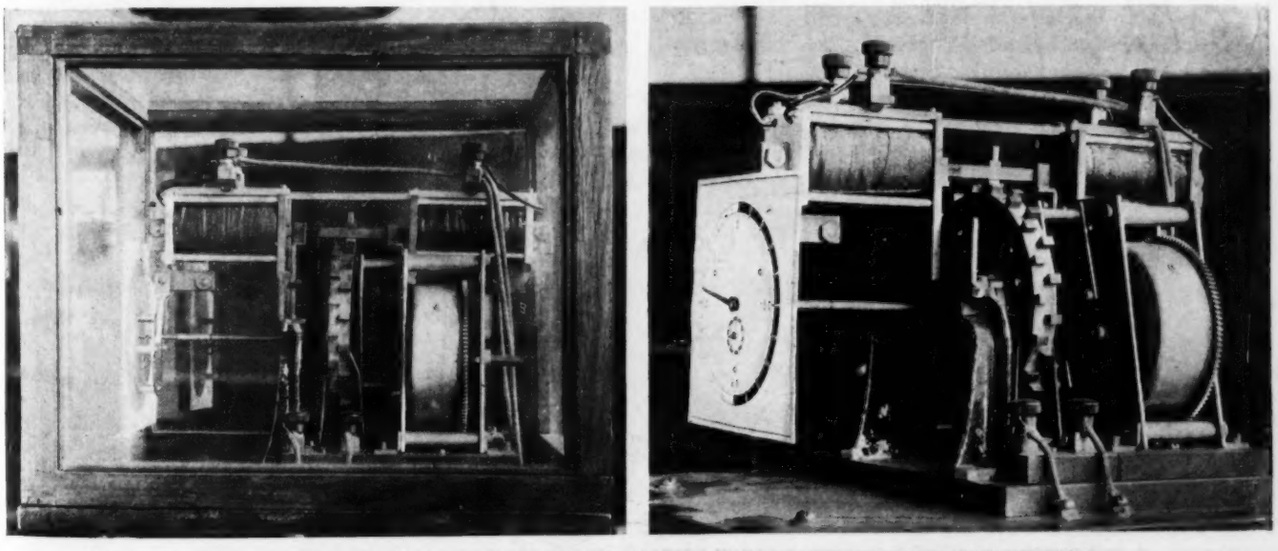


TIMING DEVICE USED BY THE METER DEPARTMENT OF THE MEMPHIS POWER & LIGHT COMPANY

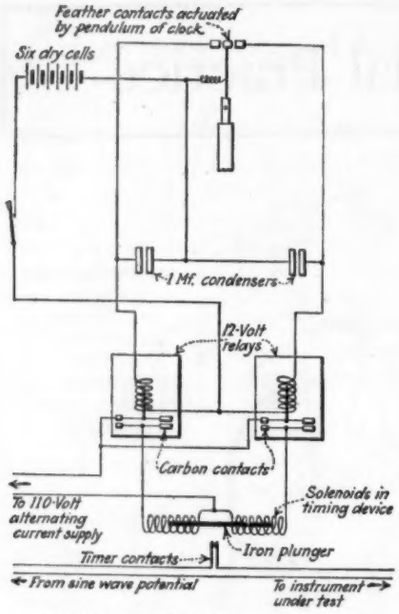
These coils are mounted in a brass and aluminum frame, for rigid construction and non-magnetic circuit, 3 in. apart so that the ¾-in. plunger may operate in both coils. The plunger has a ¾ x 5/16-in. lug mounted on its bottom and in the middle. The lug engages with a specially constructed brass ratchet gear 5 in. in diameter and ½ in. wide with 40 teeth ⅜ in. wide and ¾ in. high cut alternately on outer edges as shown in the illustrations. This brass gear has a fiber plate mounted at the outer end of the spokes and on the felloe of the wheel. A pair of contacts make contact on and through the felloe of the gear wheel for one-half revolution and is then broken by this fiber plate for the next half revolution. One half revolution of this wheel corresponds to 20 seconds. By means of a short-circuiting switch the fiber plate may be short circuited and any combination of 20 seconds of time may be obtained. This switch must be opened on the "on" side of the scale described below so that the contact may be broken at the proper time by the fiber plate. The making and breaking of the contacts is extremely rapid due to the spring action of the clock.

Both the pointer illustrated and the gear wheel are mounted on the same shaft. The pointer operates over a 40-second scale, one half of the scale showing "on" and the other half "off." A smaller pointer geared to the larger one has a range of ten minutes.

The control for the coils is supplied by a standard clock equipped with feather contacts which make and break contact of a 12-volt direct-current circuit through relays which



METER TIMING DEVICE FROM WHICH ANY COMBINATION OF 20-SECOND PERIODS MAY BE OBTAINED



CONNECTIONS OF TIMING DEVICE AND CLOCK APPARATUS

in turn alternately make and break a 110-volt circuit through the two coils of the timing device. These coils require from 1¾ amp. to 2 amp. to operate the plunger back and forth across the ratchet wheel, depending upon the temperature and also on the tension of the clock springs. The feather contacts are equipped with condensers to prevent arcing and the relays with carbon breakers.

The voltage supply for the 110-volt coils is from the house circuit. A sine wave generator set supplies the potential to various meters under test.

Checking Corrosion of Tower Footings

BY N. P. CARLSEN, JR.
Assistant to Engineer of Operation
Pacific Gas & Electric Company,
San Francisco

WHEN galvanized-steel towers or poles were first used to support transmission lines it was thought that the concrete footings would be free from maintenance, but this has not proved altogether correct. Inspection of a great many towers which have been in service on the Pacific Gas & Electric system from five to ten years has shown evidences of corrosion. Rust was found to have attacked the towers, particularly at the joint between the concrete and steel legs.

When the concrete footings were poured they tended to set with a slight saucerlike depression around the steel stubs. Moisture gathering in these depressions is not able to drain and stands around the steel stub for several months, eventually breaking down the galvanizing and setting up corrosion. If not arrested, this corrosion will eat through the stub in a short time.

A second cause of corrosion is the dirt thrown on top of the footings by plows, where the lines pass through agricultural country. This dirt packs around the steel stub and fills the depressions in the concrete, after which it becomes wet and eventually attacks the galvanizing. Another cause is from landslides, particularly where towers have been built on steep hillsides. In this case all four footings have been found completely covered, and in some cases the steel was buried under 2 ft. to 3 ft. of dirt and rock.

Once the protective coating of galvanizing is broken down, there is little that can be done except to check

Location of Carrier Current Installations (All Manufacturers)

Corrected to May 4, 1927

INDICATION OF THE EXTENT TO WHICH CARRIER CURRENT EQUIPMENT HAS BEEN INSTALLED BY UTILITIES FOR LOAD DISPATCHING

the corrosion. This has been done with some success by cleaning the affected parts with steel brushes and chipping hammers, then painting with red lead, followed by a coat of graphite paint. More recently the company has had better results by cleaning with a sand blaster and painting with a spray gun. The advantage of the air-sand blaster and paint gun are that where a latticed-steel member is involved a much better cleaning and painting job can be done. Where the depressions on top of the footings are quite deep, they are filled with asphalt. Where side hills are bad, sufficient dirt is cleared away to insure that if further slides occur they will not cover the footings. In agricultural country it is necessary to clean the footings annually, for the reason that each year new dirt is thrown on the footings.

In the experience of the writer, it has been observed that earth footings are not subject to corrosion so readily as concrete footings, because the moisture sinks into the ground instead of standing around the stub as it will do with concrete footings. However, it has been found that earth footings, particularly in alkaline soils, are subject to severe corrosion about 18 in. below the ground line. In several cases it has been necessary to remove an entire stub and replace it with a new one. This can be readily done with an earth footing by jacking up the corner of the tower while the change is being made.

In view of this experience, concrete footings might be better designed if the tops were crowned and allowed to stand at least 12 in. above the ground line. It is also good practice to inspect both earth and concrete footings at least once a year.

Removal of Broken Condenser Bolts

BY E. H. KIRCHNER
Chief Engineer Winona (Minn.) Plant, Mississippi Valley Power Company

IN THE head end of some of the smaller sized surface condensers there are three bolts that pass through the partition dividing the intake and outlet chambers. These bolts are threaded at both ends, the outside end taking a nut and the inside end screwing into the tube plate. It has happened once or twice in the Winona plant of the Mississippi Valley Power Company that one of these bolts has broken, possibly due to crystallization caused by vibration and the strain created when the outside nut was taken up. The removal of the broken end of the bolt which was screwed into the tube plate was always a considerable job, because the entire head of the condenser had to be taken off to get to the broken piece. This seemed like unnecessary work, and finally the following simple procedure was devised:

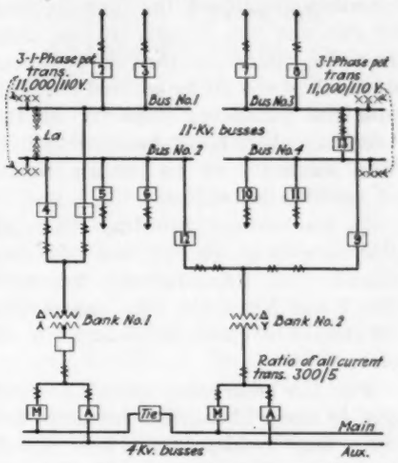
A left-handed drill smaller than the diameter of the bolt was secured and an extension welded to its shank. Now when one of these bolts breaks off, the outside end is pulled out and the drill inserted in the hole and started into the bolt end. Usually before the drill has gone completely through the length of the broken piece remaining inside it will seize, and since it is being turned in a left-handed direction it unscrews the bolt and the broken piece may be brought out without any trouble.

Sectionalizing Bus Permits Smaller Breakers

BY V. P. BRODSKY
Pittsburgh Branch, Byllesby Engineering & Management Corporation

WHEN changes of any extent are being made at a substation, requiring the installation of additional lines, it is necessary to check the interrupting capacity of the oil circuit breakers in order to make sure that their new duties will not exceed their rated interrupting capacity. A problem of this kind has been economically solved by the design engineers of the Duquesne Light Company in connection with an increase from four to eight in the number of 11-kv. lines at the Allegheny substation.

The double-bus principle was used in the orginal installation, with four 11-kv. lines supplying the main and auxiliary bus on the lines and transformers. Because it has been found that when one or two line breakers out of the total of eight were taken out of service for maintenance the remainder of the lines carried the



COMPLETE SINGLE-LINE DIAGRAM OF REVAMPED SUBSTATION

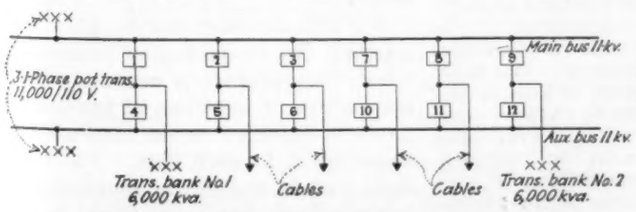
transformer load satisfactorily, it was decided to discontinue the use of the 11-kv. auxiliary bus and thus reduce the cost represented by the extra equipment.

A check of the short-circuit duties of the line and transformer breakers for the simplified installation proposed showed that these duties were considerably higher than the safe rating of the circuit breakers. To remedy this situation three solutions were considered:

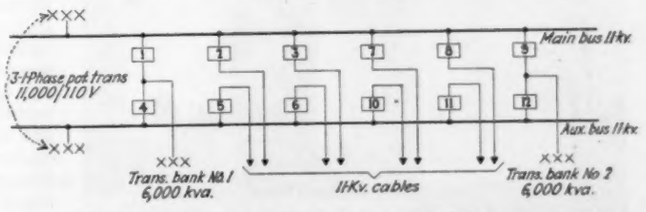
1. The installation of circuit breakers of a much higher interrupting capacity. This would have necessitated a complete rebuilding of the high-tension compartments, as they were entirely inadequate for the proposed new equipment.

2. The installation of a synchronizing bus and reactors between the synchronizing bus and the station bus, with the practical rebuilding of the high-tension bus and compartments.

3. The splitting of the two buses into four sections, with the partial rebuilding of four of the breaker compartments for breakers of somewhat larger interrupting capacity.



SINGLE-LINE DIAGRAM OF 11-KV. BUS AND CONNECTIONS BEFORE ALTERATIONS



SCHEMATIC ARRANGEMENT SHOWING INTERMEDIATE STEP IN DESIGN OF SECTIONALIZING BUS

The last-mentioned scheme was finally adopted as most economical under the circumstances. From an inspection of the accompanying single-line diagram of the revamped substation it is evident that when all the transformer breakers and the tie breakers are closed, the four sections of the bus will form one bus unit. In order, therefore, that the splitting of the bus should be carried through and the rupturing capacity of the breakers should not be exceeded, it was necessary to set certain limits of running schedules.

In the normal running order all line breakers except No. 11 are closed. If transformer breakers No. 1 and No. 4 are both closed, No. 12 should be open, No. 9 and No. 13 closed.

For the emergency running order one or more 11-kv. line breakers are open, but breaker No. 11 is closed. If No. 1 or No. 4 is open, No. 12 may be closed, but No. 13 should be open. It may be possible to close temporarily all four transformer breakers with not more than five line breakers on buses No. 1, No. 2 and No. 3 closed and breaker No. 13 open. However, this is not recommended, as some of the breakers in the event of a fault developing would be called upon to interrupt short-circuit currents approaching the limits of their rated capacities.

Rural-Line Specifications—XI

Of the Wisconsin Power & Light Company

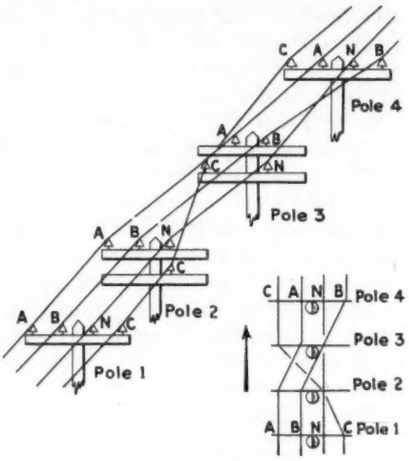
Conductor Connections and Transpositions

WHEN facing* the direction which the line feeds, the neutral conductor will occupy the right-hand pole pin. After lines are in service, it is also well to use other means for determining the location of the neutral to avoid any accidents or mistakes. On poles on which the conductors are placed vertically the neutral conductor is to be the third wire from the top.

Conductor Connections.—Whenever any taps are made to aluminum conductors, they should be made with clamps. For connections between copper and aluminum, clamps with copper lining on one side and aluminum on the other side should be used. "Hot-line" clamps having large contact areas for connections to small transformers may be made of either metal where transformer wiring is copper and line conductors are aluminum. However, aluminum line clamps are preferred for contact on aluminum conductors. It is necessary that all types of clamps be securely attached to avoid any possibility of loose contacts.

*If a line can be supplied from either end, one's back should be toward the principal source of supply so that one will be facing the principal direction which the lines feed.

Ground Connections.—The neutral-line conductor is to have no other connection to earth than that provided at the substation and through neutral arresters. The connections to earth for both transformer secondary and primary arresters must be well made. The connections between earth and arresters or secondary must not be less than No. 6 copper,



TRANSPOSITION METHOD

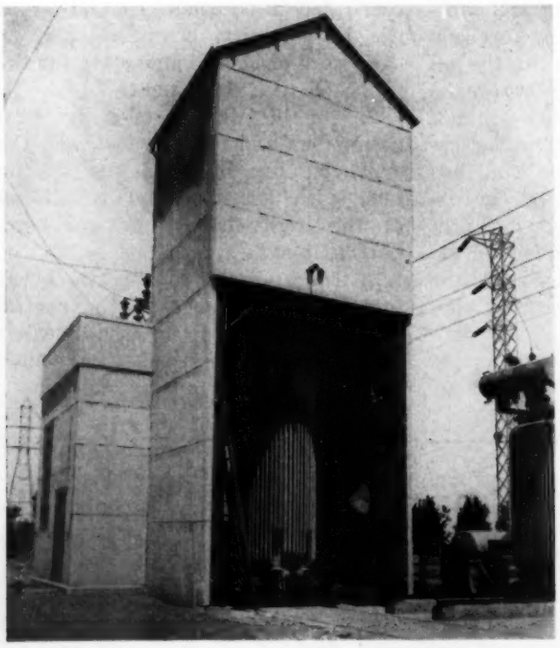
neatly covered with wood molding and protected from becoming disconnected.

The arrester ground pipe or rod is to be driven 1 ft. away from the pole and the connection placed under the surface of the soil at least 6 in. The secondary ground pipe or rod is to be driven not less than 4 ft. away from the pole and on the opposite side of the arrester ground. The connections from the pole to the rod should be double and placed under the surface not less than 6 in.

A 1¼-in. x 10-ft. galvanized wrought-iron pipe or ⅝-in. x 10-ft. copperweld rod may be used for the purpose of grounding. In each case approved fittings must be used. All grounds must be tested after installation. If found to be inadequate, additional or longer pipes or rods must be used to bring the resistance within requirements.

No definite rules can be made regarding the frequency of transpositions; it therefore is necessary that the matter of locations of transpositions be referred to the engineering department in each case. The plan indicated in the figure represents a usage which has been found to be adaptable to local conditions.

Transformer Repairs Facilitated by Use of a Special Building



AT OUTDOOR substations where there is no building with sufficient headroom to provide for transformer repairs the Great Western Power Company of California erects a structure similar to the one shown in the illustration at left. The building is of steel frame covered with corrugated iron and provided with chain blocks capable of handling loads up to 15 tons. A track connects with any one of the main transformer positions to facilitate substitution of the spare for a damaged transformer. Normally the spare is kept in the building as shown. As a definite location for spare equipment is provided, frequent shifting of such apparatus in the station yard can be avoided.

Commercial Activities and Public Relations

Transformer Capacity for Range Load

By B. E. Ellsworth
Engineer Nebraska Gas & Electric Company, Lincoln, Neb.

THE question of selecting the proper sized transformer for a given number of ranges has given rise to many and varied opinions. It is the purpose of this brief article to give a method for closely estimating the proper size of transformer for a given range load. The values for the curve are taken from the N.E.L.A. publication No. 267-23, entitled "Results of Range Load Survey." From this curve it is seen that the average maximum demand per range customer falls off rapidly, due to the diversity factor of the load, as the number of range customers on a given transformer is increased.

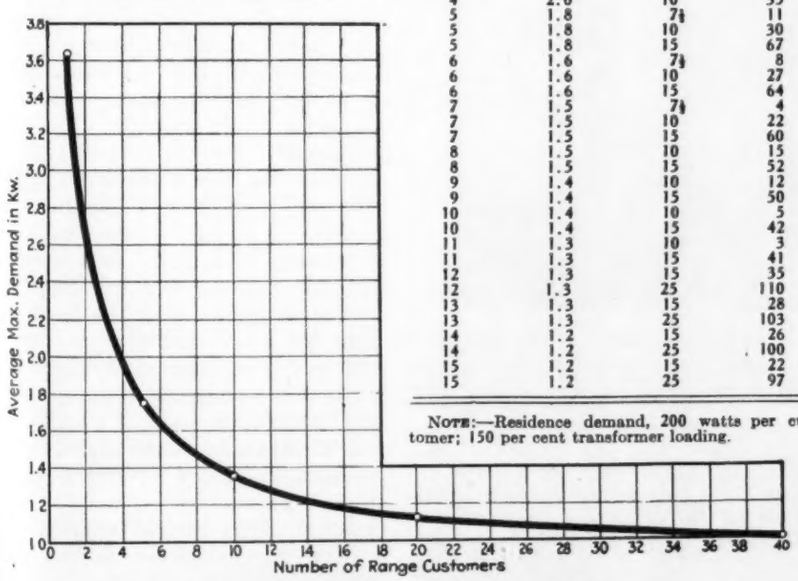
Transformers are installed by the Nebraska Gas & Electric Company of sufficient size so they will not be loaded over 150 per cent on peak load. In estimating the lighting load of the average residence, 200 watts maximum demand seems to give a very close approximation. With these two constants in mind and taking the maximum demand of the range customers from the curve, a table can be compiled that will give the size of transformer required to feed any combination of ranges and lighting customers. Peak loads are assumed to come at the same time, as they do in the winter months.

A table such as this is shown, including from one to fifteen ranges on one secondary and transformers up to 25 kva. It is an easy matter to extend this table if more than fifteen ranges are to be found on any one transformer. As an example, let us assume we have seven ranges and 40 additional residence customers to be served from one transformer. By referring to the table it will be seen that a 15-kva. transformer will carry the load easily and a 10-kva. unit will be loaded over 150 per cent. A 10-kva. transformer will, however, carry seven ranges and 22 additional residence customers. A table such as this can be compiled by any operating company according to the transformer loading standards adopted by that company. If loading on transformers is kept below 100 per cent, this will of course change the value in the table.

RANGE AND RESIDENCE CUSTOMERS PER TRANSFORMER

Number of Range Customers	Average Demand per Range Customer	Size of Transformers, Kva.	Additional Residence Customers
1	3.6	5	20
1	3.6	7½	56
2	2.7	5	10
2	2.7	7½	29
3	2.2	5	5
3	2.2	7½	23
3	2.2	10	42
4	2.0	7½	16
4	2.0	10	35
5	1.8	7½	11
5	1.8	10	30
5	1.8	15	67
6	1.6	7½	8
6	1.6	10	27
6	1.6	15	64
7	1.5	7½	4
7	1.5	10	22
7	1.5	15	60
8	1.5	10	15
8	1.5	15	52
9	1.4	10	12
9	1.4	15	50
10	1.4	10	5
10	1.4	15	42
11	1.3	10	3
11	1.3	15	41
12	1.3	15	35
12	1.3	25	110
13	1.3	15	28
13	1.3	25	103
14	1.2	15	26
14	1.2	25	100
15	1.2	15	22
15	1.2	25	97

NOTE:—Residence demand, 200 watts per customer; 150 per cent transformer loading.



MAXIMUM DEMAND OF RANGE CUSTOMERS

Electricity Usage on California Farms

THE extent to which electricity is used on California farms is indicated by accompanying data collected by the California Committee on the Relation of Electricity to Agriculture. The survey was carried out under the direction of Ben D. Moses, director and secretary of the committee, and was made by sending out a post card questionnaire. Power companies sent out 48,852 of these cards, of which 8,950 were returned. The cards contained 87 questions covering number and size of appliances in use in the home and on the farm, number of motors and connected load and use to which they were put and many other questions.

Almost 20 per cent of the cards

TABLE I—TOTALS AND AVERAGES DERIVED FROM CALIFORNIA RURAL SURVEY

A large percentage of electric motive power is for irrigation pumping

Rural customers receiving service	210,000
Rural customers receiving lighting service	186,560
Rural customers receiving heating and cooking service	13,650
Rural customers receiving power service	48,460
Farmers receiving service	51,000
Farmers receiving lighting service	49,800
Farmers receiving cooking and heating service	9,060
Farmers receiving power service	40,320
Total horsepower connected agricultural power load	635,913
Total kilowatt-hours consumed for agricultural power	712,947,487
Total annual revenue agricultural power load	$11,010,694.15
Average connected load (power only) hp.	15.77
Average annual consumption (power only), kw.-hr.	17,652
Average annual revenue (power only)	$273.08
Average price per kilowatt-hour (power only)	$0.0154
Per cent of farmers receiving service	40

TABLE II—HOUSEHOLD APPLIANCES IN USE ON 49,800 CALIFORNIA FARMS (1925)

Approximately 23 per cent of farms use electric range

Appliance	Total for State*	Saturation Per Cent
Flat irons	34,800	69.8
Washing machines	18,000	36.1
Vacuum cleaners	17,800	35.7
Toasters	17,000	34.2
Curling irons	11,980	24.0
Ranges	11,300	22.7
Portable fans	10,000	20.0
Space heaters	9,360	18.8
Percolators	9,200	18.5
Water heaters	6,710	13.5
Waffle irons	6,420	12.9
Sewing machines	6,400	12.8
Table grills	5,480	11.0
Heating pads	5,320	10.7
Bell transformers	4,980	10.0
Immersion heaters	1,000	2.0
Ironers	820	1.6
Dish washers	170	0.3
Other uses	10,900	

* Based on the assumption that 8,950 cards returned out of 48,852 sent out were representative of the entire group.

TABLE III—ELECTRIC LIGHTS IN USE ON 49,800 CALIFORNIA FARMS (1925)

Location	Total for State*	Average Number Lamps per Location
Residence	527,700	10.60
Barn	48,700	0.98
Poultry house	45,700	0.92
Pump house	27,100	0.54
Yard	26,200	0.53
Garage	22,400	0.45
Dairy	18,700	0.38
Shop	17,680	0.36

*Based on the assumption that 8,950 cards returned out of 48,852 sent out were representative of the entire group.

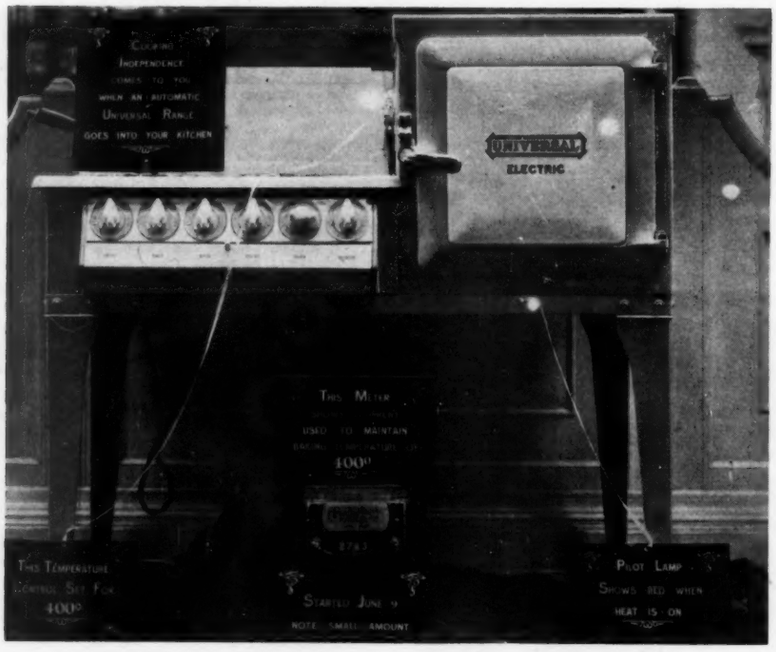
TABLE IV—MISCELLANEOUS ELECTRICAL APPLIANCES IN USE ON 49,800 CALIFORNIA FARMS (1925)

Appliance	Total for State
Incubators	5,700
Battery chargers	5,130
Poultry brooders	4,400
Horse clippers	180
Trucks	20
Sheep shears	20
Other uses	700

were returned, and after an extensive field check to determine that the cards returned were representative of the total group of 51,000 farms receiving service, a multiplication factor of 5 was used to arrive at the totals presented in the accompanying tables. Classification of customers by California power companies did not permit of differentiating between "rural customers" and "farms" and it was necessary to have power company district managers who were intimately familiar with the territory estimate the number of actual farm customers. A farm was defined as a place that produces agricultural products and upon which either the owner, tenant or hired help depends for livelihood. In this manner it was found that out of 210,000 rural customers on the books of the power companies in 1925, 51,000 farms were receiving electrical service. This indicates that a little more than 24 per cent of customers carried as rural are actually farms. It shows also that on the basis of 128,000 farms in California, as indicated by the 1920 census, 40 per cent are receiving central-station electric service.

It should be pointed out in connection with Table I that a large percentage of the electric motive power used on California farms is used for irrigation pumping. In addition to giving other interesting information Table II shows that approximately 23 per cent of farm customers use electric ranges.

Demonstrating Energy Requirements of Electric Range



BY METERING the heat losses in a representative household-type electric range, where both the range and meter can be observed simultaneously, the Hartford Electric Light Company arouses much popular interest in the low cost of electric cooking. The range shown was placed in circuit June 9 with the oven thermostat set for 400 deg. F. and the watt-hour meter set at zero, with pilot light indicating the intermittent flow of energy into the oven-heating elements. The range is continuously connected to the supply circuit and on this basis is requiring between 7 and 8 kw.-hr. per day to maintain the above-mentioned baking temperature day and night—a most abnormal requirement in relation to domestic practice, but interesting evidence of the ability of the manufacturer and utility company to provide service under even these severe conditions at moderate cost.

65,000 Free Samples to Introduce New Lamp

TO FAMILIARIZE customers with the general advantages of the new-style lamps as compared with the older ones, the Louisville Gas & Electric Company delivered one 100-watt inside-frosted "Mazda" lamp to each residential customer of the electric department. Advertisements in the newspapers preceded the distribution and announced that to accomplish this the company had received 65,000 incandescent lamps, said to be the largest single shipment ever made.

Michigan Company Secures Extensive Publicity

THE completion of the new million dollar building of the Consumers Power Company in Jackson, Mich., afforded excellent opportunity for securing editorial recognition in the local newspapers and provided the basis for some effective advertising. The Jackson *Citizen Patriot*, recognizing the community importance of the event and the extent to which the utility has gone in rendering statewide public service, devoted a 32-page section to the company's developments. The "Consumers Power Building Edition" contained news items relating to the building and its formal opening, a record of the phenomenal growth of the company, personal sketches of its officers, items concerning its activities and policies, descriptions of various plants and other items of allied interest. The Commonwealth Power Corporation, its relation to the Consumers Power Company and to the community and the policy of the corporation in endeavoring to be more than merely a holding company were outlined.

The co-operation of the local business houses, equipment companies and power consumers in purchasing advertising space and running related advertisements assisted greatly. Of the 32 pages, approximately 24½ were devoted to paid advertising and 7½ were occupied by editorial reading matter. This section supplemented twelve pages devoted to the usual news.

APPLIANCE TESTING RECORD

NO.

DEVICE Waffle Iron MFGS. Manning Bowman

NAME PLATE DATE 1/21/27 VOLTS 110 AMPS 6 WATTS 660

NEW APPLIANCE CUSTOMER X Mrs. L. M. Damage - 3044 Curtis Ave.

KIND OF TEST Customer complains iron "Sticks"

Condition of irone when rec'd. Grids indicated something sharp had been used to clean them and there were rough spots - this makes waffles stick. Cleaned grids used sand paper to smooth rough spots - Re-waxed with paraffin wax Results of baking are on opposite side of card.

(OVER)

OPERATING DATA

Current on 11:30 A.M. Regulated

Volts 116 Watts 670

- 110 - 660

Pre-heat 10 minutes before starting to bake.

Wattage held constant after first 5 min at exactly 660 watts

Baked 3 waffles - each waffle required 2½ min. for medium brown. If lighter brown is desired 2 min. is sufficient

Results were very satisfactory waffles did not stick

Caution to customer. Do not use sharp knife to scrap grids - Use wire brush and also use some sort of fat in batter.

DATE Jan. 26, 1927 TESTED BY Home Service (AR)

CARD ON WHICH TEST WORK IS RECORDED FOR FILE

Handling Appliance Complaints

WHEN patrons of the Nebraska Power Company, Omaha, complain that an appliance does not work properly, it undergoes a rigid test by the company's home service department on its specially wired testing table and a complete record of the findings is kept on the appliance-testing card shown herewith. In this way complaints of this kind are more satisfactorily adjusted, the director states. All information, such as the condition of appliance when received, cause of trouble, operating data, repairs needed and recommendations to patrons to insure future efficient use, is noted on both sides of the card, also the date and name of person who tested it.

1,367 Washers Sold in One Month

Utah Power & Light Company Again Conducts Successful Campaign Under Slogan "A Copper Washer for a Silver Dollar"

IN THE face of unprecedented competition and a greater degree of saturation the Utah Power & Light Company closed its eighth successive annual March washing machine campaign with the sale of 1,367 machines, bringing the total sold since 1920 up to 9,979. For the sixth time the famous slogan "A Copper Washer for a Silver Dollar" was used. This slogan seems to have played an important part in the success of these annual campaigns, and it is probably safe to say that it is familiar to every individual who is residing in the company's territory.

The plan of the campaign was similar to that of previous years, with the introduction of several new ideas to stimulate interest. Newspaper display was the basis for most of the advertising. Direct-by-mail broadsides were sent out just prior to the beginning of the campaign, and during the sale a large amount of attention was centered on store and window displays, animated characters in the windows being used to advantage during a part of the time. Quotas were set for each district and interest of the entire sales force was maintained at a high pitch throughout the campaign by enthusiastic meetings. Daily sales letters were sent out by the general sales department announcing the results by divisions for each day's activities and containing messages of encouragement.

Participation in the campaign by employees other than the regular sales force was made possible by the payment of $2 in cash to each employee for every prospect resulting in a sale. A stunt for the regular sales force which created a great amount of interest was a punchboard in each of the ten divisions. Corks were inserted in the board and for each sale the salesman was allowed to pull one of the corks and possibly win a prize in accordance with the number or notation he drew. In addition to the prize money on the punchboards a bonus system was in effect, the money being distributed to the divisions on the basis of excess over quota. This money was in turn distributed by each division manager among the employees in his division participating in the campaign in proportion to their sales.

The quota of 1,000 machines was apportioned among the company's ten divisions according to the number of customers in each. Terms were $1 down and $5 per month. Sales during the previous years culminated in the following results: 1920, 1,711; 1921, 1,168; 1922, 1,191; 1923, 1,118; 1924, 1,148; 1925, 1,264; 1926, 1,012.

STORE AND WINDOW DISPLAYS WERE A SPECIAL FEATURE OF UTAH POWER & LIGHT COMPANY'S ANNUAL WASHER SALE

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Flexible Handling of Coal in Quantities.—A system of interlocking bridges permitting long conveyor runs has been devised to facilitate the handling of coal in storage yards. Under this plan conveyors and trolleys operate from a junction tower and derive their flexibility through the use of tracks upon which the bridges may be shifted.—*Iron Age*, July 7, 1927.

High-Pressure Turbines in Industrial Power Plant.—Industrial plants of many kinds are now using high-pressure service. Data regarding service capacity, initial steam pressure, total steam temperature and exhaust conditions are given for installations in the plants of 26 large industrial concerns.—*Power*, July 12, 1927.

The Coal-Treatment Laboratory; Birmingham University. — Equipment for the exhaustive study of the subject of prepared coal has been installed at Birmingham University in a special, elaborate testing laboratory. Apparatus is provided for the study of briquetting, pulverized fuel, colloidal fuel, washers of various kinds, cleaning devices, concentrator tables, pneumatic separators, and furnace and boiler equipment for testing combustion results and practices. — *Engineering (England)*, June 24, 1927.

A Steam-Pressure Transformer.—This paper presents an analysis of Koenemann's recently devised process for raising the pressure of exhaust steam. A comparison is given, showing apparent advantages over the mechanical method employing a centrifugal compressor. The comparison indicates three desirable features of the Koenemann system: (1) Higher efficiency, (2) the absence of moving parts except for a small pump, and (3) the possibility of obtaining steam at pressures considerably higher than is practicable with a centrifugal compressor, and consequently better adaptability for use in multiple-effect evaporators. — *Mechanical Engineering*, June, 1927.

Units, Measurements and Instruments

Domestic Meters.—A new type of prepayment meter has been developed by the Metropolitan-Vickers interests which incorporates several novel features. The prepayment device is so arranged that by interchanging readily detachable gears, changes and alterations may be made to adapt the meters for either pennies or shillings with but little difficulty. The change may be made on the customer's premises where the meter is installed and may be made without affecting the calibration of the meter. This permits an easy method of allowing for changing in rates as well as adaptation to the requirements of various classes of customers. The switch is of the quick make and break type, using an arcing shield. All possibility of the switch being held closed by jaw friction has been eliminated. Indicators show the coins registered and the amount paid for and unused. The meter is notable for its compact shape and light weight.—*The Electrician (England)*, July 15, 1927.

Generation, Control, Switching and Protection

Economic Methods of Improving Power Factor.—L. SCHÜLER.—Electrically driven manufacturing plants, operating, as a rule, with a rather poor overall power factor, will find it of great economical value to reduce their inductive or wattless load. It is customary (in Europe) to make a charge of ½ of the cost of one kw.-hr. in-phase load for every kw.-hr. of load with less than 0.7 lagging power factor. Three methods are investigated to improve phase displacement: (a) a replacement of some of the larger induction motors of the installation by compensated motors, (b) the acquisition of a synchronous condenser, and (c) the installation of stationary capacitators. Assuming average market prices for these three types of machines and apparatus, the author develops generally applicable formulas, which indicate the economies of these three methods for any particular case. In addition, equations are given to show within what time the initial investment disappears from the books. Consideration is limited to plants not exceeding 1,000 kw. and motors not over 200 kw. The methods given are extremely simple and lead quickly to the desired solution. — *Elektrotechnische Zeitschrift*, June 23, 1927.

Heating of Stator Coils.—SVEN HJERTEN.—In calculating the cost of material for direct-current generators or rotary converters, it will be found that a large percentage of it is contained in the main and commutating pole windings. The permissible heating of these windings and the proper disposal of the i^2r losses are the determining factors in regard to the amount of copper needed. The problem has been approached repeatedly in the past, but in all cases the inner temperature rise only was considered, while the paths along which the heat is carried from within to the surface and the cooling medium have rarely been made the basis for theoretical investigation. It is this method which the author follows, because he has found that these paths represent by far the largest resistance which the flow of heat has to overcome. The author's method determines the partial heat resistances which the flow of heat encounters on its way out, giving complete data for the calculation of pole and compensating windings. It is of interest to note the substitution of the customary terms involved in heat flow by familiar expressions for electric current, the denomination of the temperature gradient as the voltage drop, and the heat resistance as ohmic resistance in this presentation of an important feature of generator design.—*Elektrotechnische Zeitschrift*, June 9, 1927.

Transmission, Substations and Distribution

Parallel Operation of Transformers. M. VIDMAR. — The conditions under which two transformers will operate satisfactorily were known and formulated long ago. Same ratio, same connection diagram and same reactance are claimed to be needed to insure this condition. The author indicates that in practically no case does a really perfect division take place when two transformers are sharing a load. The magnitude of the internal circulating current between the two devices involves unavoidable differances in reactance and ratio. The influence of external reactors for improving parallel operation is investigated. A further and hitherto little known problem arises, when two transformers are connected over an underground cable, which compensates or over-compensates the otherwise helpful impedance of the interposed sections of connecting lines. The final chapter is devoted to an exact investigation of the influence exerted by a difference in ratios, and discloses the fact that a 4 per cent off-ratio is not nearly as harmful as the commonly permitted 10 per cent variation in reactance. The author advises replacing a transformer with one of larger size, if the demand grows beyond its capacity, rather than to connect a second transformer in parallel with the first.—*Elektrotechnik und Maschinenbau*, June 5, 1927.

A New Type of Reactor.—M. VIDMAR.—Various shapes of external reactors have been used for years as a protective measure to prevent traveling waves and dangerous over-voltages from entering transformer windings. A generously designed reactance coil with a sufficient number of turns, when placed before a large transformer, affords a considerable amount of protection. Small coils, with a few turns of cable, seen frequently in substations in series with small transformers, give no protection and may actually do more harm than good. On the other hand a large reactor may fail, due to an excessively high potential. Protection of the reactor is a problem. Campos attempted to solve it with a resistor-bridged reactor, but the solution is far from complete. If the voltage peaks are subdued, resonance may occur; if resonance is damped, voltage peaks are given free passage. The logical development would therefore point to two choke coils, one unbridged, the other shunted. To arrive at an economical solution a close magnetic coupling of these two coils is desirable. The author suggests such a pair of coils, placed concentrically around an iron core with a large magnetic gap, and gives data for the calculation of such a reactor, which seems particularly suited for the protection of small transformers. As an example, a protective reactor of this type for a 10,000-volt 100-kva transformer is computed.—*Elektrotechnische Zeitschrift*, June 9, 1927.

66-kv. Transmission Line Regulators.—A description of what is said to be the highest voltage electric power transmission system in England is given in this article. The transmission scheme includes two 66,000-volt lines,

each of 24,000 kva. capacity, connecting generating stations 30 miles apart. Power is generated at 11,000 and 6,000 volts and is transformed by means of four three-phase banks of 4,000-kva. units at each end of the line so that 48,000 kva. can be transmitted in either direction. The flow of power is controlled by means of equipment installed at both ends of the line, each being a combination of a booster transformer and a voltage regulating auto transformer with tapping switches. The auto transformer is energized from the station busbars, and by means of the tapping switches supplies the primary winding of the booster transformer at variable voltage according to the requirements needed to meet line voltage. Step-by-step regulation without interruption of supply, involving the closing of each selected tapping switch before the existing connection on the adjacent tapping switch is broken, is accomplished by the use of a reactance connected between the two tapping switches while the change is taking place, this connection being made effective by opening a switch which is normally closed across the reactance. The sequence of operations following a movement of the master controller is entirely automatic, first the opening of the reactance switch renders the reactance operative, then the selected tapping switch closes and immediately afterward the superseded tapping switch opens; the change having been effected, the reactance switch recloses. — *Electrical Review (England)*, July 1, 1927.

Heating of Underground Cables.—R. DELACOUR AND L. ROUSSEL.—A large part of the Parisian distribution system comprises 12,000-volt, four-conductor, two-phase underground cables, which are laid out either in cement canals in tiers of nine cables in one vertical row, or are buried in the ground in two horizontal layers. Plans for enlarging the cable system by laying more cables in the canals made it desirable to establish the amount of heating due to these additional cables. Exact measurements were carried out in the canals, in which were placed as many cables as the augmentation called for. Average current was passed through them, and a number of recording electric thermometers were located on and around the cables. These tests were made for both the cement canal and the trench installation and were carried on for periods of one, ten, and 80 days, with the cables laid out in various arrangements. The authors point out that the heating of accumulated cables in a trench or a canal is beyond theoretical calculation, as the contributing factors cannot be generalized. Actual test measurements, under the particular conditions involved, offer the only possible method for determinations. The data given apply to this particular Parisian installation, and are only relatively applicable to any other cable system.—*Revue Générale de l'Electricité*, June 11, 1927.

Cable Operation.—An analysis of cable installation in a number of cities throughout the United States showing causes of cable failures and failure of joints is included in the underground systems committee report of the National Electric Light Association. More than 9,000 miles of cable and 178,000 joints are involved in the analysis. Failures are allocated to some 24 known causes.—*National Electric Light Association* (1927).

Heat Applications and Material Handling

Calculation of the Plate Thickness of Dished Heads.—A. HUGGENSBERGER.—The stress conditions in elliptical shells are established from theoretical and experimental analyses. On the basis of the relation between the radius of curvature and maximum stresses, the danger of rupture in small radius boiler knuckles is approximately determined. A calculation of the thickness of the plate according to the Hamburg rules is discussed and it is shown that the use of too small a value for the radius of the knuckle will give too small a value for the thickness of the plate. This is explained with reference to the tensile strength of the material and to a head tension with insufficient radius of curvature of the knuckle. Thus the appropriate head tension can be so shown that the usual calculations will give the correct thickness of the plate. — *Mechanical Engineering*, June, 1927.

Torsional Fatigue Limits. — T. H. BURNHAM.—Recent experiments by Dr. Föppl in connection with the behavior of structural steel under repeated torsional stress have led to increased knowledge on this subject. Tests were made with a specially designed and formed specimen and the results plotted. The effect of surface scratches upon the strength of the material is given consideration. — *Engineering (England)*, July 8, 1927.

Cable Armoring.—What is said to be one of the largest machines ever built for the armoring of electrical cables, has recently been installed in an English plant and is described in this article. This machine is notable for its flexibility and may be used to apply any type of armoring to cables, up to 5¼ in. in diameter. As many as 120 wires can be applied in one layer. — *The Electrician (England)*, July 1, 1927.

Electrophysics, Electrochemistry and Batteries

Further Study of Geometrical Calculation of Illumination Due to Light From Luminous Surface Sources of Simple Forms.—ZIRO YAMAUTI.—Three methods are used in calculating illumination due to surface sources of simple forms. Calculations involve unit sphere, integration along the closed boundary of the source, and use of the illumination vector. The subject is approached entirely through the mathematical viewpoint. No. 194, *Researches of the Electrotechnical Laboratory, (Japan)*.

Effect of Repeated Stress on Magnetic Properties.—The results of investigations by the Bureau of Standards indicate that the application of static axial stresses below the elastic limit do not produce a permanent change in magnetic properties after removal of the stress. Repeated bending, such as occurs in the usual rotating beam fatigue test, results in easily measurable changes in magnetic permeability. The changes take place most rapidly in the early part of the test and proceed at a decreasing rate as the test is continued. It has been found that five cycles of stress are sufficient to bring about a measurable magnetic change. The magnitude of the magnetic change depends upon the intensity of the stress and the number of repetitions. This investigation is being continued, and it appears very probable that much can be learned of the fatigue of metals that could be learned in no other way.—*Technical News Bulletin of the Bureau of Standards*, July, 1927.

Telegraphy, Telephony, Radio and Signals

Battery Eliminators. — PHILIP R. COURSEY. — Rectifying arrangements for use on alternating-current circuits constituting a supply of energy for radio receiving apparatus are discussed in this article. The extended use of these appliances, desirable elements of design and the influence of these devices upon the installation and characteristics of the receiving sets, are considered by the author. The insertion of a suitable insulating condenser in the normal earth connections of the radio receiver, which will not interfere with the operation of the set but will obviate any risk of short circuit for supply sources, is suggested. The eliminators supplying low voltages are designated as being particularly faulty from the engineering point of view.—*Journal of the Institution of Electrical Engineers (England)*, July, 1927.

Miscellaneous

Calculation of Fluid Friction in Pipes.—A. J. NICHOLAS.—The many experiments conducted to determine the relation of pipe size, velocity and pressure loss in pipe lines have led to the derivation of numerous formulas for use in calculating friction losses. As a result it is difficult to choose a formula applicable to a pipe line layout for a given fluid. The author cites the value of a graphical method of finding the loss of head, applicable to any pipe line, and recommends a simplified loss-of-head determination.—*Power*, July 12, 1927.

Effect of Various Pipe Metals on Water.—H. W. CLARK.—Results of experiments undertaken in an endeavor to ascertain the cause of corrosion in water pipes and fittings indicate that whatever pipe is used a certain amount of metal will be taken into solution by the water and this amount varies under different conditions and with different waters. If the pipe is of iron a greater amount is taken than for pipe of any other metal. Galvanizing an iron pipe prevents to a large extent the absorption of iron, but zinc is taken into solution as long as the galvanizing lasts. Brass pipe yields a large quantity of zinc, but generally only small amounts of copper. Copper pipe yields only about the same amount of copper as brass pipe, but zinc is not involved in the corrosion of these pipes except occasionally.—*Canadian Engineer*, July 12, 1927.

New Books

Principles of Mercury-Arc Rectifiers and Their Circuits

By D. C. Prince and F. B. Vogdes. New York: McGraw-Hill Book Company, Inc. 233 pages, illustrated.

In presenting this text on rectifiers the authors have used a treatment which appears to them to be suited especially to American engineering practice. They have not limited themselves in the amount of space devoted to mathematics, but have picked out such processes as set forth to their minds the physical conceptions of the problems. The first part of the book begins with a discussion of the physics of several simple types of rectifiers and with the mercury-arc rectifier. In this section the authors have included the results of the work of many men as well as a description of their own work. In the second part of the book use has been made of a mathematical paper, by Walter Dallenbach and Eduard Gerecke, on the "Current and Voltage Conditions in the High-Capacity Rectier," published in the *Archiv für Elektrotechnik*. The remaining chapters of the book deal with the more involved problems which predominate in high-power rectifier practice. Enough illustrations of apparatus have been used to show the result of theory in practice rather than to convey a comprehensive idea of commercial practice.

Electrical Engineering Laboratory Experiments

By C. W. Ricker and C. E. Tucker. New York: McGraw-Hill Book Company, Inc. 310 pages, illustrated.

The changes made in this second edition constitute such general revision of each experiment as four years' use of the text suggests as advisable. Additions have been made to the laboratory outlines of "Results Required," and several of the items considered less serviceable have been altered or deleted. Experiment numbers have been added to each page to facilitate the locating of assignments.

Public Utility Finance

By Walter E. Lagerquist. Chicago: A. W. Shaw. Price, $7.50.

It would be difficult to find any subject bearing upon the financing of public utilities in all branches that is not dealt with by some recognized authority in Mr. Lagerquist's "Public Utility Finance," published recently for the Institute for Research in Land Economics and Public Utilities. The compilation is a singularly complete analysis of the industry. Although the traction companies probably receive more attention than power and light companies in the volume, the financing of the latter is dealt with at great length in the various excerpts chosen as most suitable to conform with the sequence of the work. The great advantage of a work of this kind is that definite subjects are dealt with by experts rather than by a single editor who gives information which he has received from experts more or less at second hand. In many instances sections dealing with specific subjects have been prepared by the national association representing the particular branch of the industry concerned. Although this method of procedure frequently has the fault of presenting only one side of a mooted question, the author has shown unusual skill in choosing those articles which present both sides in a fair and equitable manner.

Repair-Shop Diagrams and Connecting Tables for Induction Motors

By Daniel H. Braymer and A. C. Roe. New York: McGraw-Hill Book Company, Inc. 232 pages, illustrated. Price, $2.50.

The object of this book is to furnish repair men and armature winders with practical step-by-step instruction on laying out coils for induction-motor winding and connecting the ends of the group of these coils in proper sequence of phase and pole groups for different types of windings used in motors of from two to twenty-four poles, two-phase and three-phase. The information presented can also be used when reconnecting the coil group to satisfy changes in voltage, changes for operation on circuits with a different number of phases, different frequencies or changes in speed of the motor. The definite information in the book is contained in diagrams and tables, as stated in the title. The first few chapters of the book contain explicit directions on the use of these diagrams and tables, and the remaining chapters are each devoted to a specific type of motor or connection.

Manual of the Endurance of Metals Under Repeated Stress

By H. F. Moore. Baltimore: Waverly Press, Inc. 63 pages, illustrated.

Presentation is made in this book of an up-to-date statement of the existing knowledge of the fatigue of metals in a form which should prove useful to designing, operating and testing engineers. Most of the investigations are being continued, with much research work remaining to be done, particularly that relating to determining the nature and the general laws of fatigue phenomena. A page is devoted to the definitions of special terms used in the text, and there is also appended a brief reference list for further reading on the subject.

A Manual of Automatic Telephony

By Charles W. Wilman. London: Crosby Lockwood & Son. 223 pages, illustrated. Price, 7s. 6d. net.

This volume deals in an elementary manner with the principles underlying the art of automatic telephony. The greater part of its contents is based upon lectures given by the author to students at the Coventry (England) Municipal Technical Institute. No attempt is made to describe in detail the system of any one manufacturer, but examples of the application of the general principle to the problems of modern practice are given. These examples are drawn from the step-by-step system. The special problems of automatic telephony in very large areas, which have come into considerable prominence during recent years, are dealt with in the latter part of the book. The volume is well illustrated with circuit diagrams and pictures of modern equipment. Since the book is addressed primarily to the British reader, there may be some things in it which do not fit exactly into American practice, but since the art of automatic telephony has been developed by close co-operation between those interested all over the world, such divergencies should not be of great moment and the book should have a distinct value in the field of automatic telephony in America.

The Essentials of Transformer Practice

Second edition. By Emerson G. Reed. New York: D. Van Nostrand Company, Inc.

The first edition of this work was printed in 1923. New material amounting to about 50 per cent of the original has been added. The book has a distinct value to operating men, for, although the greater part of the text is concerned with principles of transformer design, the presentation of these principles is lucid and an understanding of them furnishes a solid base for perfect comprehension of operating conditions. Moreover, operating conditions *per se* are not neglected in the book; they are treated adequately. All types of transformers, including reactors, receive consideration, and the principles of design and performance of all are explained. Characteristics of liquid and solid insulations are gone into at some length and theories of their behavior under electrostatic stress are discussed. A captious reviewer might find occasion for a few remarks about the desirability of meticulous proofreading.

Inventions and Patents, Their Development and Promotion

By Milton Wright. New York: McGraw-Hill Book Company, Inc. 225 pages.

All engineers and many who are not engineers nurse the ambition to invent and patent. The next step is to market the invention and then become wealthy. The road to success, however, is long and filled with pitfalls, and the author of this book in presenting this road and these pitfalls to would-be inventors has done well. In a clear and interesting manner inventions, choosing patent attorneys, getting a patent and marketing a patent are in turn presented. A wealth of human experience and illustrative instances and a very entertaining style enrich the book. It is replete with good sense and information and is well worth reading for the warning and wisdom which it contains.

News of the Industry

From the Nation's Capital

Reports of Secretary Work's Colorado River Advisers Due in Few Weeks —Utilities Committee Moves

REPORTS that Senator Waterman of Colorado had resigned as one of Secretary Work's advisers on the Colorado River are denied at the Interior Department in Washington. He is expected to submit an individual report, as is each of the other members. In addition to the report each member will make, it is probable that all will join in a general statement. The separate reports will begin to reach Secretary Work before the end of August, it is thought.

The Joint Committee of National Utility Associations will move into its offices in the new Washington Building in the capital on Sept. 1. The Washington office of the committee is in charge of Josiah T. Newcomb, its counsel and Washington representative.

Alabama Tax Bill Signed by Governor Graves

Bibb Graves, Governor of Alabama, lost no time in affixing his signature to the bill passed recently by the Alabama Legislature, as noted in the ELECTRICAL WORLD for July 23 (page 178), by which a tax of two-fifths of a mill per kilowatt-hour will be imposed on all hydro-electric power generated and sold in that state. This tax alone, it is estimated, will in four years increase by a sum in the neighborhood of $2,000,000 the amount to be paid in taxation by the Alabama Power Company, and other increases in taxation to which that company has been made liable will bring the extra imposts probably to more than that amount.

Kansas City Power & Light Reduces Rates Voluntarily

The Kansas City (Mo.) Power & Light Company on July 30 filed with the Missouri Public Service Commission a new schedule of rates covering residence and commercial lighting service and general power service. The schedules, if sanctioned, will become effective Sept. 1. The reduction in residence rate affects 88,409 domestic customers in the Kansas City district, while the change in the commercial lighting rate will affect 17,072 additional customers. The reduction of the general power rate will affect 3,250 small power consumers in the Kansas City district and 4,343 customers in the smaller towns served by transmission lines.

The reduction was made by changing the rate in the first step. For residence lighting the first 5 kw.-hr. per room per month will be charged at 7 5 cents instead of 7 cents per kilowatt-hour. The first 60 hours' use per month of the maximum demand on commercial lighting was reduced from 7.5 to 7 cents. The first 60 hours' use per month of the maximum demand on the general power rate was changed from 6.5 cents to 6 cents.

Work Begins on Hydro Plant at Chippewa Falls, Wis.

Marking the start of the largest hydro-electric development in recent years in the Central Northwest, construction of the power plant of the Northern States Power Company at Chippewa Falls, Wis., is under way. It is to cost $3,500,000, and a thousand workmen will be employed at various stages of the project, which is to be completed before the close of next year. The new plant, which is to have a capacity of 27,000 hp., divided among six generating units, is to be built inside of the city limits of Chippewa Falls, about two miles downstream on the Chippewa River from the power company's present Wissota development, the capacity of which is 42,000 hp. As explained by Charles F. Stuart, assistant to the general manager of the Northern States Power Company, this arrangement permits "putting the water to work" twice in half an hour. There will be a 27-ft. head of water.

Surplus power from the Chippewa River plant will be made available for use in Minneapolis and St. Paul, reducing fuel consumption at the steam stations, while in times of low water energy generated in the steam plants in Minneapolis and St. Paul can be transmitted to districts normally served by hydro-electric plants.

Herminghaus-Edison Hearing Is Set by Supreme Court

October 3 has been set by the Supreme Court of the United States as the date for arguments in the case of the Herminghaus heirs vs. the Southern California Edison Company. Decision in the original suit was rendered by the Superior Court to the effect that the Southern California Edison might not impound the waters of the San Joaquin River and its tributaries to such an extent as to prevent the annual overflow of the river and the constant inundation of the Herminghaus acreage, and the company was enjoined from storing flood waters of the river in its Florence Lake reservoir. The Edison company contended that the method used by the plaintiff was wasteful and that under the water commission act the company had the right to impound water that otherwise for the most part would flow unused into the ocean. The Supreme Court of the state upheld the decision of the Superior Court, and the Edison company appealed to the Supreme Court of the United States to review the case.

Announcement has been made by the Edison company that financial arrangements have been made by the company with the Herminghaus estate for impounding this year's run-off from the San Joaquin River in the Florence Lake reservoir.

As a result of the decision rendered in the Herminghaus case, a constitutional amendment limiting riparian rights to a reasonable and beneficial use of the water was, as previously reported, passed by both houses of the last California Legislature and will be submitted to the voters in November, 1928.

Senator Walsh to Press for Investigation

Montana Man to Ask Action in Next Congress on His Motion to Inquire Into Growth and Financing of Electric and Gas Companies, Both Holding and Operating

ACCORDING to an article in the *United States Daily*, of Washington, Senator Walsh of Montana recently announced that at the coming session of Congress he will press for action along the line of his resolution, introduced at the last session of Congress. This resolution calls for the appointment of a sub-committee of five members of the Senate directed to inquire into the growth and financing of all public utility corporations supplying either electrical energy or gas and of corporations holding the stocks of such public utilities. The resolution covers not only the so-called holding companies, but also every concern supplying electricity or gas. There is no limit as to size or location. If the resolution is passed, public utility companies of this character, large and small, anywhere in the United States, will be within the field of investigation.

Mr. Walsh explained that under his plan the investigation will include the method of issuing and the price realized or value received for security issues. Extensions of the property of the operating companies and the value or detriment to the public of holding companies are other subjects which Mr. Walsh says would fall within the scope of investigation if his resolution carries. One object, he explains, is to determine what legislation, if any, should be enacted by the new Congress.

Maryland Commission Busy

Court Proceedings and Rivalry of Central-Station Companies Continue to Demand Its Attention

ALTHOUGH the Public Service Commission has twice denied it permission to acquire four small power companies in western Maryland, the Electric Public Utilities Company of Chicago, through its Baltimore attorney, has filed a bill in equity to permit the transaction. It is alleged that the commission made an arbitrary exercise of power in refusing the Chicago company the right to purchase the four smaller companies. A date for the court hearing will be set for some time next month.

An investigation into the charge by the Consolidated Gas, Electric Light & Power Company of Baltimore that the Northern Maryland Power Company was acquired by the Philadelphia Electric Company in violation of a section of the public service law will be made by the Public Service Commission, Harold E. West, chairman, said this week. Mr. West asserted that no formal notice of the transfer of control of the Northern Maryland Company had been given the commission. Whether the commission has the power to regulate the sale of a Maryland power corporation which is controlled by a foreign holding company is in doubt, Mr. West said.

Attorneys for the Northern Maryland Power Company, which is protesting against allowing the Gas company to serve Havre de Grace, told the Public Service Commission that unless the Gas company filed a list of its extensions, in compliance with the court order reported last week, in a reasonable time before the hearing it would have to ask for a postponement of proceedings. A hearing had been scheduled for Wednesday.

North Dakota's New Utility Law to Be Tested

Controversy over the question of what company shall furnish the city of Kenmare, N. D., with electric service is expected to result in the first test of the public utilities law which was passed by the last session of the State Legislature. This law provides that any public utility company must obtain a certificate of convenience and necessity from the State Railroad Board before it can legally begin its operations.

Kenmare is now being served with electricity by the Montana-Dakota Power Company, one of the largest central-station companies in the state. Recently the City Council granted a franchise to M. A. Erickson, who operates a power plant at Rugby, giving him the exclusive right to sell electric service in Kenmare. At the same time the Council directed the Montana-Dakota company to remove its equipment. Mr. Erickson then filed an application with the board for a certificate of convenience and necessity, and the Montana-Dakota company resisted the granting of the application. It contends that it is already serving the city adequately at a fair price. Hearing in the case will be conducted in the latter part of August.

If the board should hold that the issuance of the certificate asked by Erickson is not justified, the question of relative rights of the state commission and the city councils with regard to the control of public utilities will be raised. Such a decision would mean in effect that while cities retain the right to issue franchises, such franchises do not become effective unless the State Railroad Board approves them.

Electragists Will Talk at St. Louis for Co-operation

At the annual convention of the Association of Electragists International, which will be held at the Hotel Chase in St. Louis from Monday to Friday of next week, business sessions will be supplemented by an extensive manufacturers' exhibition. The convention will stress the necessity for close co-operation between the different groups in the electrical industry, and spokesmen for the other associations in the industry will take a prominent part in the discussions.

The executive committee of the electragists will meet on Tuesday to consider policies for the future. In the afternoon accredited representatives of local and state associations of electrical contractor-dealers will meet. Later a round-table discussion of the problems of local and state secretaries, executive managers and association officers will be held.

On Wednesday a general session will be held, devoted to the subject of "A United Industry." The session will be opened by Clyde L. Chamblin, president of the Association of Electragists International. He will be followed by Howard T. Sands, president of the National Electric Light Association; D. Hayes Murphy, vice-president of the Supplies Division of the National Electrical Manufacturers' Association, and Albert L. Salt, president of the Graybar Electric Company.

On Thursday the general subject of discussion will be "Selling Our Service." Addresses will be made by W. W. Freeman, president of the Society for Electrical Department; H. H. Courtright of the Valley Electrical Supply Company, of Fresno, Cal., and Earl Whitehorne, chairman of the industry conference on wiring. In the evening the annual banquet will be held. On Friday, Aug. 12, the meeting will close with committee reports.

Every facility will be provided for delegates to visit manufacturing plants, jobbing establishments and public utility plants in and around St. Louis.

Proceedings on Cove Creek Made Public

Examination of the Three Cabinet Members Who Compose the Federal Power Commission Brings Out Their Disposition to Await Congressional Action

PROCEEDINGS in executive session held just before Congress closed by the House committee on military affairs, and dealing with the Muscle Shoals situation, have just been made public. They involve, among other matters, the examination of the three Cabinet members—Secretary of War Davis, Secretary of the Interior Work and Secretary of Agriculture Jardine—who compose the Federal Power Commission.

Asked whether he cared to express an opinion as to how the Muscle Shoals problem ought to be solved, "in view of the great doubt and conflict of opinion in Congress," Secretary Davis said he "would rather not work out an opinion until something is worked out by Congress."

Secretary Work and Secretary Jardine were questioned regarding their view of the licenses asked by private promoters to develop the Cove Creek water power on the Upper Tennessee. Issue of this license was strongly opposed by Chairman James of the committee, who said:

"If we have to operate it ourselves, we shall get 134,000 additional horsepower for $20,000,000. Every witness who has testified before us has said that in case somebody else besides the government built Cove Creek Dam, and we have Muscle Shoals, the power can be regulated up there so as to interfere with our property at Muscle Shoals. In other words, they could practically destroy the value down there."

Further comment was made by a member of the committee that the Cove Creek Dam is not primarily a local power project but a storage project, and that the manner of regulating the discharge of the water at that dam would determine the continuity of the power below, to which Secretary Work responded: "I can see where it will be an advantage to the Muscle Shoals Dam, of course. But we own the Muscle Shoals Dam now, and if we go ahead and complete the Cove Creek Dam, or allow it to be completed, that will detract from the value of our property."

"You have a plant there" (at Muscle Shoals), was Secretary Work's final statement, "and if you cannot sell it, you will have to operate it or lose money."

Secretary Jardine said that while the Federal Power Commission is confronted with demands from Tennessee and other citizens for power, he would not, as a member of the commission, want to take action as to Cove Creek against the recommendations of the sub-committee. He said every time an additional dam is constructed it adds to the value of Muscle Shoals, "and we have been holding out until this can be settled here."

"We have been going on with Muscle Shoals for seven or eight years," Mr. Jardine continued, "and we are suffering down there. We have been holding off on these dam sites. We have three applications before the Federal Power

Commission for temporary permits. I am constitutionally opposed to the government getting into the business that private concerns ought to do. You are raising the question: Will it not be the best way for the government to go in under our direction and engage in the manufacture of fertilizer? And can we not settle the question as to whether fertilizers can be manufactured and demonstrate to the farmers that it is practicable? That is the question. I do not want to commit myself on that. But I do not want to get into a place where folks can accuse me of being for government ownership and operation, and yet I want to be practical as to that."

He said that he would rather put Muscle Shoals in the hands of private people on the basis of power and that he thought everybody agreed that the government ought to keep control of the nitrogen-manufacturing plant.

Kentucky Utilities Company's New Building Program

Further expansion of business in various sections of the territory served by the Kentucky Utilities Company, together with anticipation of the needs of customers in the not distant future, has resulted in the preparation of a new building and reconstruction program in the last thirty days involving the expenditure of more than half a million dollars.

The major item on this program is the construction of a 66,000-volt, double-circuit steel-tower transmission line from the Earlington power station to Morganfield, a distance of 38 miles, at an estimated cost of $310,900. It will be separate from the 33,000-volt line already in operation and loaded to capacity. The new line will be an important link in the power loop interconnecting the transmission systems of the Central Illinois Public Service Company and the Kentucky company, including the Earlington, Graham, Paducah, Grand Tower and Muddy generating stations, via Paducah and Cairo, Ill., on the west and Morganfield on the east.

Other new construction will include a 33,000-volt single-circuit line from Bardstown to New Haven, a 33,000-volt line from Madisonville to Hanson, a 6,600-volt line from Paducah to Lone Oak, and a 66,000-volt, 20-mile line from Pineville to Manchester. New distribution systems and substation equipment will bring the total outlay up to $500,000.

Steel Gates to Raise Height of Dix Dam

Announcement was made at Lexington, Ky., on July 29 by officials of the Kentucky Utilities Company, controlling the Kentucky Hydro-Electric Company, to the effect that arrangements were being completed for the installation of a system of steel gates over the spillway of the Dix River Dam which would enable the company to store water for an additional height of 10 ft. during freshet periods, thus materially increasing the storage and generating capacity of the plant at Herrington Lake. By raising the level 10 ft. water sufficient to operate the plant for thirty days could be impounded. The statement in part read:

"The spillway of the dam was cut through the solid rock at the time the dam was constructed and is a virtual river when the water is high. The proposed plan is to put huge steel gates at the spillway to stop the flow of water through it, in order to raise the level of the lake. The gates will be so designed that they will be operated by electric motors receiving power from the electric plant and can be raised to allow the escape of surplus water in the lake due to floods or excess high waters. With these huge gates in place, the upper reaches of the lake will be extended for at least a mile further than it now reaches and several feet wider on each shore. The lake at present is 35 miles long and from 100 yd. to 1,000 yd. wide, with a depth ranging from 50 ft. to 250 ft."

Dix Dam, which required two years to build, is one of the highest dams east of the Rocky Mountains. It is 920 ft. long, 700 ft. thick and 270 ft. high.

Washington, Too, Claims First Place in Rural Service

California's claim to lead by a wide margin all the states of the Union as regards rural electrification, as noted in these columns on July 16 (page 128), is evidently not accepted by one of her sister states on the Pacific, Washington. In a recent letter to stockholders of the Puget Sound Power & Light Company, its president, A. W. Leonard, says:

"A survey completed by the National Electric Light and Power Association points out that only 3 per cent of the farms of the United States enjoy the advantages of electric service. The State College of Washington, which has made a similar survey in this state, finds that, with 55 per cent of all Washington farms receiving electric service, this state leads all others in rural electrification. In the area in which the Puget Sound Power & Light Company operates over 70 per cent of all farms are electrified. More than 35,000 farms are connected to the 2,900 miles of rural transmission and distribution lines built by the company."

Projects in the Dominion of Canada

Proposed Developments on the Ottawa River Still Attract Interest—New Unit at Farmers Rapids—Progress at Grand Falls—Ontario Hydro's New Rates

BESIDES the question of St. Lawrence development, referred to at length last week, the Canadian government is still occupied with the question of power development on the Ottawa River. The government has not yet decided what it is going to do with the much-discussed Carillon Falls. The National Hydro-Electric Company has not given up hopes of obtaining an extension of its lease, but before anything is decided the long-talked-of conference between the federal and the Ontario and Quebec governments will probably be held.

In the meantime plans appear to be in the making for a huge hydro-electric plant on the Ottawa River in the vicinity of Chats Falls, about 30 miles above Ottawa. The Gatineau Power Company has for some time had engineers engaged in a general survey of the power potentialities of the upper river.

The second unit of the new power plant of the Gatineau Power Company at Farmers Rapids, on the Gatineau River, has been turned over and is now in operation. This unit and the first one, which was started on May 8, are supplying power to the new newsprint mill of the Canadian International Paper Company at West Templeton, Quebec. The mill is also receiving power from three units in the power house at Chelsea, a mile above the Farmers Rapids plant. Work on the power development at Farmers Rapids was commenced in January, 1926, and was carried on continuously through the winter months. At the height of the construction work on the Chelsea and Farmers Rapids developments and the paper mill 6,500 men were employed.

Work on the Grand Falls power development, on the St. John River in New Brunswick, which will eventually supply many thousands of horsepower for pulp and paper mills in that province and for other purposes, is now five or six months ahead of schedule, and should be ready for installation of machinery before the first of December this year. Construction work is being done by the Dominion Construction Company under a contract given by the St. John River Power Company which obliges the contractors to complete the work by July, 1928, but barring unforeseen delays, the construction will be finished before the end of this year. Between 350 and 400 men are now employed in building the dam and power house and in driving a tunnel 2,700 ft. long, which passes right under the main business section of Grand Falls and will carry the water from the dam to the generators, three in number, each capable of developing 20,000 hp.

The Ontario Hydro-Electric Power Commission has just announced that, following the completion recently by the commission's engineers of the analysis of the cost of supply to each class of consumer, the commission has authorized a reduction in lighting rates in 44 municipalities and an increase in lighting rates in four municipalities. The commission has also authorized a reduction in power rates in 132 municipalities and an increase in power rates in one municipality. As a result of the cut the Welland rural district enjoys one of the lowest rates on the continent. The consumption rates have been reduced from 4 and 2 cents to 3½ and 2 cents. The old rate for farms from 10 to 50 acres was $2.40 gross, the new rate being $1.71 net. For farms over 50 acres the old rate was $3.15 gross, while the new rate is $2.25 net.

Purchases and Mergers

Foshay Acquires Three Plants in Idaho —Transactions in New York, Middle West and Southwest

PHYSICAL properties of the Canyon Light & Water Company of Burke, Idaho, and the Mullan Light Company of Mullan, Idaho, and the capital stock of the Northwest Light & Water Company at Wallace, Idaho, have been contracted for by the W. B. Foshay Company of Minneapolis. Transfer of the properties will be concluded in August, at which time they will be made part of the Public Utilities Consolidated Corporation.

The Arizona Corporation Commission on July 28 granted permission to the W. B. Foshay Company and allied corporations to transfer a part of their holdings to the Public Utilities Consolidated Corporation of Arizona. Permission was also granted it to purchase the Desert Power & Water Company of Kingman, Ariz.

The Niagara Electric Service Corporation of Niagara Falls has petitioned the New York Public Service Commission for approval of the merger of the Lewiston Power Corporation and the La Salle Electric Corporation, it having acquired ownership of all of the stock of these two companies.

The New York State Gas & Electric Corporation has petitioned the Public Service Commission for permission to acquire all of the outstanding capital stock of the Georgetown Electric Lighting Company, already controlled by it, and to merge the two companies.

A certificate has been filed in the office of the Secretary of State of New York merging with the Adirondack Power & Light Corporation the Consolidated Electric Company of Greenwich. The latter is capitalized at 21,000 shares of $100 par value.

The Illinois Public Utility Company will pay the village of Waynesville, Ill., $6,000 for its electric light plant and lines and has received a 30-year franchise.

The properties at McCook and Gothenburg, Neb., operated by the Nebraska Light & Power Company have been purchased by the United Gas Improvement Company of Philadelphia and will be operated in connection with its chain of electric properties in northern Iowa.

At a special election held at Redfield, S. D., the citizens voted to sell their electric light and power plant to the Northwest Public Service Company for $150,000 cash. A twenty-year franchise has been granted.

The Arkansas Power & Light Company has purchased the Bradford (Ark.) power plant.

Fairland, Okla., has voted to sell its municipal distribution system to the Empire District Electric Company, to which it has granted a 25-year franchise.

The California Railroad Commission has granted permission to McKinley Brothers to sell their electric system in the town of Middletown, Lake County, to the California Telephone & Light Company for $9,000.

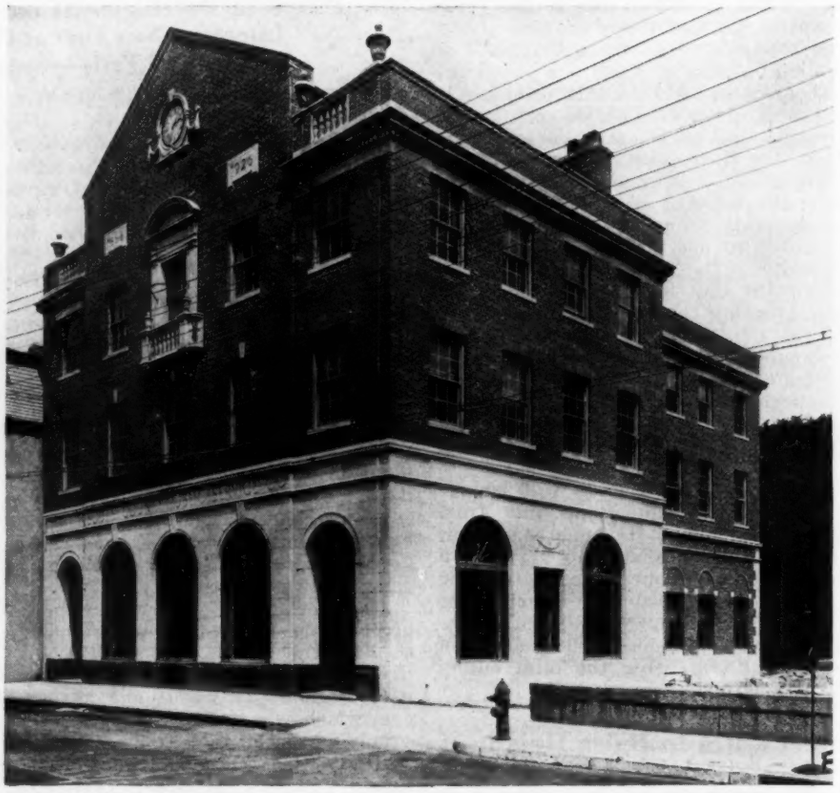
The Quebec Power Company has purchased all the properties and interests of the Corporation d'Energie Electrique de Montmagny and its two subsidiaries. the Compagnie d'Energie Electrique de Montmagny and the Compagnie Electrique de Bellechasse. The transaction involves holdings and property to the value of nearly $2,000,000. The Montmagny company and its subsidiaries supplied light and power to a number of municipalities on the south shore, which will now be served by the Quebec Power Company.

Anderson (Ind.) City Plant Objects to Cutting Rates

City officials of Anderson, Ind., are said to be incensed over a report of the Indiana State Board of Accounts which holds Anderson's municipal light plant rates to be too high and says that a 40 per cent reduction should be made. Officials term the report unfair in view of the fact that light rates at Anderson are low in comparison with those of other cities of the state. The report has been termed a move on the part of politicians to secure control of the management of the plant's affairs. The city controller of Anderson is asking the transfer of $48,000 of the electric light plant earnings to the city general fund to be used in meeting current city expenses. For the first half of the present year earnings of the plant, according to the auditor's report, amounted to $326,100 and operating expense to $175,229, leaving a large net operating revenue. The depreciation fund contains $248,292, and a major improvement fund started in April contains $30,000. The total bonded debt of the plant on June 30 was $148,500.

The Delco-Remy Corporation at Anderson, employing more than 7,500 persons, surprised the City Council recently with a proposal that an outside utility company be permitted to extend a power line into Anderson for a connection with its plants for emergency use. The request aroused opposition in the Council, which presumed that the Northern Indiana Power Company, with a line near the city, would be the outside utility. The Council took no action on the request except to voice sentiment against outside competition. The Delco-Remy plants now use power from the municipal installation. It is said that the corporation has demanded a substantial reduction in rates.

Westerly (R. I.) Electric Utility Moves to New Home



THE South County Public Service Company has recently moved into its new building on High Street, Westerly, R. I. The formal opening was held on Saturday, July 16, when about 4,500 customers and friends inspected the new quarters. The building, of simple Colonial design, is constructed in T-shape, the front of the T facing 50 ft. on the street. The length of the building is 83 ft. The first floor is devoted to a large and attractively laid out salesroom with the sales manager's office at the rear; the second floor is occupied by the general offices, and the third floor contains an auditorium for the social activities of the employees and also the quarters of the engineering department, including the offices of the general superintendent, plant engineer, lighting engineer and others. The sides and front of the ground floor are of Westerly granite and the remainder of the exterior is brick.

Merger Is Disapproved

Pennsylvania Commission Refuses to Let Metropolitan Edison Absorb Eleven Small Utilities

"OBVIOUSLY inflated costs" was given as the reason why applications of the Metropolitan Edison Company for approval of the acquisition of the capital stock of eleven electric companies operating in the southeastern part of Pennsylvania were denied on July 30 by the Public Service Commission of that state. Denial of the applications is the first based on the ground that the costs are excessive and would be a burden upon the public and the operating concerns. The commission said it would be inclined to approve the applications of the companies where the acquisition cost is less than the depreciated value, if the interest charge were eliminated.

The companies which the Metropolitan Edison Company, now operating in a broad field between the Delaware and the Susquehanna Rivers, desired to acquire are the Annisville & Palmyra Electric Light Company, Boyertown Electric Company, Birdsboro Electric Company, Topton Electric Light & Power Company, Berks-Lehigh Electric Company, Weissenberg Township Electric Light & Power Company, French Creek Electric Company, Bernville Light, Heat & Power Company, Hamburg Gas & Electric Company, Blue Mountain Electric Company and the Orrtanna Electric Light & Power Company. These companies operate in Lebanon, Montgomery, Berks, Lehigh, Chester, Dauphin and Adams Counties. All of these companies purchase their entire supply of electricity, or most of it, from the Metropolitan Edison. With the exception of the Blue Mountain and the Bernville companies, they own and operate no generating systems.

According to the terms submitted to the commission, the Metropolitan Edison Company was to pay $2,302,918 for the eleven companies, which was to be furnished by the General Finance Corporation, a holding company, and this amount was divided as follows: Stocks heretofore acquired, $514,927; cost of stocks to the General Finance Corporation, $1,626,441; interest to July 1, 1927, $156,076; miscellaneous expenses, $5,474. The item of interest was not in accord with the system of accounting used by the commission, which believed that when the companies became merged the difference between the aggregate cost and the par value would be charged against the Metropolitan Edison Company's surplus, thus creating an unwarrantable burden.

Harrah (Okla.) Plant Will Be Greatly Enlarged

Announcement that the capacity of the Horseshoe Lake generating station near Harrah, Okla., would be nearly doubled and that the work of making ready for the new generating equipment would begin soon was made recently by J. F. Owens, vice-president and general manager of the Oklahoma Gas & Electric Company. The Horseshoe Lake plant at present is capable of generating 35,000 kw. and is the main plant in the company's system, helping to supply electric service to 157 Oklahoma towns and cities. With the new turbo-generator of 25,500 kw., the plant will become one of the largest electric generating stations in the Southwest.

Reasons for the increase, as given by Mr. Owens, are to take care of the increasing demand for power from oil fields and the normal increase of electric light and power demand all over the company's system. It will take a year's time to complete the building extension, enlarge the substation and install the general and auxiliary equipment.

Court Regulates Competition in Hartington, Neb.

The District Court sitting at Hartington, Neb., has issued an injunction permanently restraining the Interstate Power and the Cedar Light & Power Company from placing into effect at Hartington, where a city plant recently began service, the 6-cent top rate schedule announced in competition with a 9-cent city rate, and from putting in effect there any rate that is below cost or less than fair market value or than the defendants are accustomed to demand for energy in other towns in northeastern Nebraska where costs of production are similar. (See ELECTRICAL WORLD for April 2, page 725, and April 23, page 881.) The court finds that the defendant companies conspired to drive their competitor out of business in violation of the common law and the anti-discrimination statutes of Nebraska, electrical energy being a commodity and a manufactured product within the provisions of those enactments. It further expresses the view that the defendants, which included the Tri-State Utilities Company, predecessor in ownership of the Interstate, have in the past been demanding and receiving exorbitant rates and rendering poor and inferior service; that the city authorities, being unable to secure a reduction from the 14-cent top rate, contracted with the Hartington Electric Light Company to build a plant with a top rate of 9 cents; that the defendants thereupon cut the price to 6 cents, which is less than it charges in other towns, and that this was done with the intent to discriminate unfairly and to stifle competition.

George A. Lee, attorney for the power companies, said that no appeal will be taken. While the company takes the position that electrical energy is not a commodity and hence the anti-discrimination law does not apply, this is merely an academic and not a practical question, Mr. Lee said. The court, he asserted, refused the state-wide injunction the Attorney-General asked and eliminated from its final order the rate of 8 cents fixed in the temporary injunction as one the company might charge, thus permitting it to charge any rate above 6 cents that is fair. As the general effect is to permit the Hartington plant to compete at rates that will not control elsewhere in the company's territory, the companies will accept the situation as upholding their primary contention that the court cannot rule out competition.

Briefer News

Wisconsin Water-Power Plan Defeated.—The joint resolution which provided for an amendment to the Wisconsin constitution so as to give the state power to acquire water-power sites, plants and water powers for the production of electricity has been killed in the State Senate.

Los Angeles Starts New Hydro Plant.—The Bureau of Power and Light of Los Angeles, Cal., has put into operation at the Haiwee reservoir on the Los Angeles aqueduct a new hydro-electric generating station. This makes four hydro plants operated by the municipality in Owens Valley, namely, Division Creek, Cottonwood, Big Pine and Haiwee. None of them is very large.

Enterprising New York Farmer Buys Water-Power Site.—More than 600 acres of land near Eel Weir, N. Y., which takes in a large part of the Oswegatchie River, with valuable undeveloped water power, has been purchased by Joseph Larus, a farmer in that section. The land which borders on the Oswegatchie has been a coveted section, and for many years the city of Ogdensburg has been urged to buy the property.

Government Renews Lease to Alabama Power Company.—The Acting Secretary of War has renewed for a period of one year the leases of the Alabama Power Company of the substation at Waco Quarry and of the electric railway at Nitrate Plant No. 2, Muscle Shoals. This property was leased originally on July 16, 1923, and the lease has been renewed yearly.

Staten Island Edison Cuts Off Power to City Trolleys.—The Staten Island Edison Company, which has supplied the power for operating New York City's municipally owned trolleys in the company's territory, the island borough of Richmond, cut off the supply on Monday, Aug. 1, because of a bill for $175,000 which the city had left unpaid. The surface lines that were thus discontinued, including 20 miles of trackless trolley, totaled 58 miles of semi-rural railway. The city substituted buses, and doubt is expressed whether the trolley service will be resumed.

Northern Nebraska Power Company to Supply Cheap Energy to Interstate Power.—The Northern Nebraska Company has virtually completed its development on the Niobrara River near Spencer and will soon be in position to fulfill the contract made with the Interstate Power Company, which supplies 47 municipalities in that section. This provides that the producing company shall furnish for the next twenty years at least 5,000,000 kw.-hr. a year for 0.75 cent per kilowatt-hour, and if a larger use is desired by the Interstate Company it will supply additional energy at the same rate. Dump power is to be paid for on the same basis. The Interstate owns several generating plants in Nebraska, but most of its

towns are supplied by transmission lines, all of which will be connected with the Northern Nebraska plant.

Chicago Contemplates Further Improvement in Street Lighting. — The commissioner of gas and electricity in Chicago is seeking an appropriation of $1,631,000 for the installation of 4,300 modern street-lighting units in residential districts at a cost of $800,000, 2,500 units on car-line and heavy-traffic streets at a cost of $365,000, and 500 lamps in subways under track elevations at a cost of $466,000.

Allegan, Mich., to Build Municipal Power Plant. — By a vote of nearly three to one, Allegan, Mich., decided recently to build a municipal lighting plant. The vote, which was 901 to 330, was on a proposal to bond the city for $185,000 to acquire a dam site on the Kalamazoo River. A campaign in favor of the plant had been carried on for weeks. The Consumers Power Company, which now serves Allegan, was understood to be seeking to acquire the same site.

New Unit for Hutchinson, Kan.—The United Power & Light Corporation plant at Hutchinson, Kan., will become one of the largest base generating power stations in Kansas when additions now under way are completed. The plans provide for the installation of a new 12,500-kw. generating unit. The company has given a contract to McClelland & Junkersfeld, New York City, for handling both the engineering and installation work. The enlargement of the plant was made necessary by the rapidly increasing use of electricity in the territory served by the United Power & Light Corporation, which includes 150 Kansas communities. During the first six months of this year 29,474,899 kw.-hr. was sold as against 25,927,721 kw.-hr. for the corresponding period last year, or an increase of 12 per cent.

New Offices of Consumers Power Company Open.—A unique christening ceremony marked the opening of the million-dollar general office building of the Consumers Power Company in Jackson, Mich., recently. A bottle containing water from thirteen rivers on which the company's water-power plants are built was broken at the entrance. In recognition of the significance and importance to the community of the completion of this eleven-story structure, which was illustrated in the ELECTRICAL WORLD for March 19 (page 623), the Jackson *Citizen-Patriot* devoted 32 pages out of a total of 48 to news and advertisements regarding the building, the Consumers Power Company and subjects of allied interest.

Norfolk (Va.) Generating Plant Now Doubled in Size.—"Tuning up" of the five-million-dollar, 30,000-kw. addition to the Reeves Avenue power plant of the Virginia Electric & Power Company at Norfolk is about over, and the plant will go on the lines probably next week, according to Thomas P. Walker, vice-president. The addition to the Reeves Avenue plant doubles its capacity and will make nearly 75,000 kw. available not only to Norfolk and Portsmouth, but also to the North Carolina and Virginia cities, towns and industries that have been or are being connected with the Virginia Electric & Power system. Company officials say the new installation will make Norfolk the most important electric power distributing point on the South Atlantic seaboard and by far the largest in the company's system. It was necessary to speed construction of the new units in order to be prepared to take care of the increased load next fall and winter.

Maine and New Hampshire Governors to Co-operate in Power-Export Legislation.—According to what is declared to be well-authenticated information, Governor Brewster of Maine, when he calls an extra session of the Legislature, which may be the first of January, will present to that body a tentative agreement with Governor Spaulding of New Hampshire that he will also convene the legislative body of that state in extraordinary session for the purpose of ratifying any compact indorsed by Maine for export of hydro-electric power. No such understanding is necessary with Governor Fuller of Massachusetts, where the Legislature meets annually. The Maine Governor will also be prepared to submit copies of recommendations made by the public service commissions of the two states that the proposed pact be entered into by their respective commonwealths.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see the ELECTRICAL WORLD for July 2, page 50.]

Association of Electragists International—Hotel Chase, St. Louis, Aug. 8-12. L. W. Davis, 15 W. 37th St., New York.

International Association of Municipal Electricians—Salt Lake City, Aug. 16-19. E. H. Benz, West New York, N. J.

Camp Co-operation VII—Association Island, Henderson Harbor, N. Y., Aug. 28-31. Society for Electrical Development, 420 Lexington Ave., New York.

National Electrical Manufacturers' Association—Policies Division, Association Island, N. Y., Sept. 1-3; Apparatus Division, Briarcliff, N. Y., Oct. 24-27.

New England Division, N.E.L.A.—New London, Conn., Sept. 12-15. Miss O. A. Bursiel, 20 Providence St., Boston.

American Institute of Electrical Engineers—Pacific Coast convention, Del Monte, Cal., Sept. 13-16. F. L. Hutchinson, 36 West 39th St., New York.

American Electric Railway Association—Cleveland, Oct. 3-7. J. W. Welsh, 292 Madison Ave., New York.

Empire State Gas and Electric Association — Lake Placid Club, Lake Placid, N. Y., Oct. 6 and 7. C. H. B. Chapin, Grand Central Terminal, New York.

Illuminating Engineering Society — Edgewater Beach Hotel, Chicago, Oct. 11-14. L. H. Graves, 29 West 39th St., New York City.

Eastern Association of Electrical Inspectors — Springfield, Mass., Oct. 12-13. E. P. Slack, 85 John St., New York.

Rocky Mountain Division, N.E.L.A.—Broadmoor Hotel, Colorado Springs, Col., Oct. 17-20. O. A. Weller, 900 15th St., Denver.

National Association of Railroad and Utilities Commissioners — Dallas, Tex., Oct. 18-21. James B. Walker, 270 Madison Ave., New York.

Southern Colorado Power Company Insures Uninterrupted Service. — The "fall-back" connection of the Southern Colorado Power Company to La Junta, built to enable the company to continue to serve that city with electricity should its 66-mile high-tension line from Pueblo fail, was completed on July 23. The plan is to get electricity in an emergency from the Holly Sugar Company's plant at Swink, just outside of La Junta, until the company's own boilers in its Swink substation could be fired, when the load would be switched on its own equipment. Failures have not occurred for two years, but the new franchise exacts this "fall-back."

Searchlight Illumination of Unprecedented Size Will Aid British Flier to Land.—When Captain F. T. Courtney, the British flier who is planning to cross the Atlantic, reaches New York Harbor he will find it illuminated by searchlights giving 18,500,000,000 cp. Arrangements for this illumination will be put into effect by the New York Edison Company, and it will provide, it is said, the greatest concentration of artificial lighting ever furnished for an occasion of this sort. A landing space for Captain Courtney one-half mile long and a quarter of a mile wide will be kept clear southwest of Governors Island. The area will be marked by four city ferryboats which will have eight searchlamps with a combined rating of 10,000,000,000 cp. On the crown of the Statue of Liberty a large beacon light will be placed to help guide the flier, who is expected to arrive between 10 and 11 o'clock at night. Another beacon will be lighted on Governors Island.

Coast Valleys Opens New Office Building in Salinas, Cal.—Approximately two thousand people took advantage of the opportunity to inspect the new office building of the Coast Valleys Gas & Electric Company in Salinas, Cal., when it was formally opened to the public recently. The building, which formerly was occupied by a banking institution, has been almost entirely remodeled. The granite Corinthian columns of the old building have been retained and stone cornices and a roof balustrade have been carried across the rest of the front to conform architecturally. The outside entrance to the second story has been removed and a marble stairway installed inside the lobby. At the formal opening the entire company personnel acted as members of a reception committee and as guides to escort visitors through the building. Demonstrations of many of the appliances on display in the lobby were given, and there were music and refreshments.

Protest Made Against Optional Rates at Anderson, Ind.—Alleging that proposed optional lighting rates filed with the Indiana Public Service Commission for Huntington, Ind., by the Nothern Indiana Power Company are not effective legally because no hearing was held and no order issued by the commission, Mark H. Thomas has filed suit against the company asking for an injunction to prevent the rates being put into effect on the bills due Aug. 1. The power

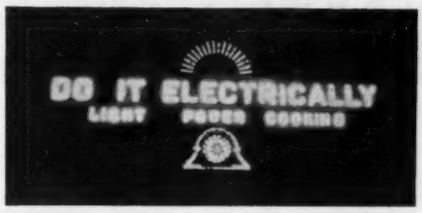
company announced that the optional rate schedule, including the active-room rating of houses, was an experiment, and that if under the optional rates the individual user's bill was larger than before, the old rate would be used. The basic charge for active rooms is quoted at 8 cents a kilowatt-hour, with a sliding scale after certain amounts have been used for each active room. The old flat rate was 9 cents, with a step down after a certain amount had been used. The optional rate system is similar to schedules that have been placed in effect by other Insull utilities in Indiana. The commission has set Aug. 9 for a hearing.

Pennsylvania State College Industrial Management Conference.—The twelfth annual summer conference for industrial executives will be held under the joint auspices of the departments of industrial engineering and engineering extension of the Pennsylvania State College from Aug. 22 to Sept. 3. Costs, personnel problems, factory location and layout, time study, wage-payment plans, industrial economics and other topics of like character form the major items of discussion. Three discussions each day, led by a faculty member, are to be held during the two weeks. Prof. C. W. Beese is head of the industrial engineering department of the college.

Columbia Gas & Electric to Dissolve Eight Subsidiaries.—Impending dissolution of seven subsidiary electric companies is announced by Edward Reynolds, treasurer of the Columbia Gas & Electric Corporation. These are the Hamilton Utilities Company, the Ohio Gas & Electric Company, the Cincinnati Suburban Power Company, the Williamsburg Light & Power Company, the Forrestville Electric Light & Power Company and the Southwestern Ohio Power Company, in Ohio, and the Cabin Creek Power Company, in West Virginia. Some of the companies are already inactive except in a coporate sense, their properties having been taken over and merged with larger Columbia subsidiaries.

Manitoba Power Company to Install New Unit This Month.—It has been announced that the Manitoba Power Company expects to complete the installation of the fourth unit of its power plant at Great Falls some time in August. A new transmission line is nearing completion which will take the bulk of the energy to Winnipeg, on the northwestern side. The Great Falls plant of the Manitoba Power Company was constructed in 1922 in such a way as ultimately to provide 168,000 hp. That is, the substructure was completed for six turbines of 28,000 hp. each, and the original superstructure left room for three units. As conditions appeared in 1922, it seemed improbable that the remaining units would be required for perhaps a decade. The superstructure now covers the whole substructure. With the fourth unit in operation and the demand for power in Manitoba growing rapidly, the company expects to install the fifth unit next year, and it is more than likely that the sixth and last unit will be in place early in 1929, only seven years after the original work was started.

Municipal Plant Adopts Industry Slogan.—In one of the largest electric signs in Florida, now adorning the roof of the municipal electric substation at Jacksonville, Fla., the city government falls in line with the electrical industry in suggesting that things be done



"electrically." The sign, which is equipped with a generator with revolving armature, motor flashes and running border, is 47 ft. above the roof of the building and is composed of 1,520 25-watt lamps with double row of sockets. It is readable for two miles. This sign was installed by the A. L. Palmer Electric Sign Company of Jacksonville.

Recent Court Decisions

Electric Company's Negligence in Grounding Transformers Used in Mill Is for Jury to Decide.—Harker vs. Southern California Edison Company was a suit to recover damages caused by a fire in a mill attributed to faulty grounding of the company's transformers therein installed. The District Court of Appeal in California sustained a verdict for the plaintiff despite technical objections raised against the procedure in the trial court. The questions of negligent installation and maintenance, inadequacy of fuses, negligence in holding current breakers at substation closed after they had kicked out, thereby overloading wires, and so forth, were all rightly submitted to the jury, the superior court held, and an error in the trial court's instructions applying the doctrine of *res ipsa loquitur* ("the thing speaks for itself") was not reversible inasmuch as other instructions repeatedly advised the jury that the specific negligence alleged must be proved to permit recovery. (256 Pac. 848.)*

Return of More than 8 per Cent Upon Valuation Cannot Be Held Non-Compensatory.—The United States Court in the Southern District of Idaho has ruled that the evidence in Idaho Power Company vs. Idaho Public Utilities Commission showed a return of more than 8 per cent upon the rate base and that therefore the rates fixed cannot be construed as non-compensatory, notwithstanding that the rates for charitable institutions, water heating, air heating and irrigation were found invalid by the court. The court held also that the commission, which erroneously refused to consider reconstruction costs in fixing the rate base, destroyed the strength of the presumption that the rates fixed were compensatory and left the question to be determined upon a clear preponderance of evidence, the burden being upon the company to establish their non-compensatory character.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Advantages of Unified Management.—The New York Public Service Commission has authorized the Queensboro Gas & Electric Company and the Long Island Lighting Company, which are affiliated corporations, to acquire and hold all or not less than two-thirds of the outstanding common capital stocks of several utilities rendering electric and gas service in territory contiguous to that served by the petitioners. In some cases there was an actual overlapping of consents which have already produced a duplication of plant and service and in the past have been a source of friction and litigation between the companies. The commission said that it was "familiar with the affairs of all of these corporations and has viewed with concern the apparent friction existing between them due to the overlapping of franchises and the duplication of service. We are of the opinion that the putting of these companies under one management would be of great benefit not only to the companies but to the public which is served by them."

Commission Will Rely on Its Own Engineer's Valuation Figures.—Holding that where the physical property of a public utilities corporation has been thoroughly checked by engineers for the state, both in place and as to its presence on the books, their figures will be accepted as conclusive evidence of the value of this property for all corporate purposes, the Nebraska State Railway Commission has ruled out of consideration the valuation of the water, light and electric plants at Nebraska City offered by the city officials. The issue was raised in a hearing in which the Central Power Company of Grand Island, which had purchased the properties from the Nebraska City Water & Light Company for $1,179,000, asked authority to issue a like sum of its own securities in payment, the plan including the dissolution of the Nebraska City company and the wiping out of its bond and common and preferred stock liabilities. The city presented as the basis of its claim that the valuation asked for by the company was more than double what it should be a set of figures made by the Prince Engineering Company in 1922, which found the reproduction new value to be a little less than $200,000. The commission rejected these figures and adopted those of its chief engineer, which substantiated the valuations fixed by the company.

Men of the Industry

A. W. Berresford Resigns

A. W. Berresford, a vice-president of the Electric Refrigeration Corporation in charge of engineering and development, has resigned. Mr. Berresford became identified with the refrigeration branch of the electrical industry early in 1926, when he was appointed executive vice-president of the Nizer Corporation, following the consolidation of that company with the Kelvinator Corporation and the Grand Rapids Refrigerator Corporation, operating as divisions of the Electric Refrigeration Corporation. He had previously been vice-president and general manager of the Cutler-Hammer Manufacturing Company for almost twenty years. An outstanding figure in the electrical industry for many years, Mr. Berresford has been the recipient of several of its highest honors. He is a past-president of the American Institute of Electrical Engineers and before election to that office in 1920 served as its vice-president and also as manager. He has also been president of the Electrical Manufacturers' Club and of the Associated Manufacturers of Electrical Supplies and is at the present time a vice-president of the American Engineering Council.

C. F. Wood, superintendent of the construction department of the Consumers Power Company at Battle Creek, Mich., has been appointed operating manager of the Mexico Light & Power Company, Mexico City. Mr. Wood has been identified with the Consumers Power Company for the past three years.

W. Paxton Little, vice-president and treasurer of the Niagara Falls Power Company, has been appointed chairman of the special technical committee on public utilities accounting of the New York Society of Public Accountants. Mr. Little also is member at large of the Accounting National Section of the National Electric Light Association.

E. D. Treanor has been appointed managing engineer of the distribution transformer department at the Pittsfield (Mass.) works of the General Electric Company. As managing engineer of that department Mr. Treanor will also have general supervision of the engineering on distribution transformers manufactured at Fort Wayne, Ind., and Oakland, Cal.

T. D. Lynch, manager of the materials and process engineering department of the Westinghouse Electric & Manufacturing Company, sailed from New York Aug. 1, on the steamer *Belgenland,* for a two months' business tour of Europe. His main object is to study methods of manufacturing in Germany and England, especially the Westinghouse distributors, Siemens-Schuckert of Germany and Metropolitan-Vickers of Great Britain. While on the Continent he will attend the meetings of the International Congress for Testing Materials, which convenes at Amsterdam, Holland, Sept. 12 to 17. Mr. Lynch is vice-president of the American Society for Testing Materials.

A. C. McMicken New President of Northwest Association

A. C. McMicken, who was elected president of the Northwest Electric Light & Power Association at the recent Salt Lake City convention, entered upon his career in the electrical industry in 1902, when he joined the supply department of the General Electric Company at Portland, Ore. Subsequently he became motor salesman for that company, but in 1907 transferred his interests to the central-station branch of the industry upon the formation of the Portland Railway, Light & Power Company, now the Portland

A. C. McMICKEN

Electric Power Company. Mr. McMicken first served this utility in the capacity of contract agent, a position he held until 1911, when he was promoted to be sales manager of the Portland division. In July, 1926, his jurisdiction was extended to all divisions of the company, and certain operating responsibilities were added to the position, so that his title was changed to general sales manager.

Mr. McMicken has been active in association affairs for many years, having served on committees of the Commercial Section of the Northwest association as member or chairman and during one administration as section chairman. In 1924-25 he was chairman of the electric range and water-heating committees of the Commercial National Section.

Prof. Elihu Thomson of Lynn and Swampscott, Mass., returned home last week after a trip abroad. During his visit in England Professor Thomson received the Faraday medal from the Institution of Electrical Engineers, concerning the presentation of which editorial comment was made in the issue of the ELECTRICAL WORLD for July 30. While overseas he visited Norway at the time of the recent solar eclipse. He returns to his work as consulting engineer of the General Electric Company after an absence of six weeks.

Frederic D. Hall, formerly electrical engineer of the Boston & Maine Railroad, with headquarters at Boston, has been appointed assistant electrical engineer of Charles H. Tenney & Company, Boston. Mr. Hall's previous work includes a long term of railroad electrical engineering service, as well as earlier connections with the Edison Electric Illuminating Company, Otis Elevator Company and Whittier Machine Company, all of Boston.

Charles Philip Coleman, chairman of the board of directors of the Worthington Pump & Machinery Corporation, has resigned. Mr. Coleman has been affiliated with the Worthington Pump organization since 1916 and prior to becoming chairman of the board a year ago served as chief executive for a period of eight years. Mr. Coleman's successor has not been chosen.

W. S. Quinlan of Cleveland has been elected president and general manager of the Robbins & Myers Company, Springfield, Ohio, to succeed **F. S. Hunting,** resigned. Mr. Quinlan has been a director of the company for several years and is intimately acquainted with the affairs of the corporation. He has had many years of experience as a manufacturer, both in the production and commercial departments, at the present time being vice-president of the Maynard Murch Company of Cleveland. Mr. Hunting, who has been president and general manager of the company since 1922, will continue as chairman of the board of directors. Formerly Mr. Hunting had spent 34 years with the General Electric Company, being in charge of the production and sale of small electric motors a large part of this time. Other changes in the reorganization consisted of the election of **Wilbur J. Myers** as vice-president and treasurer and the promotion of **O. C. Burmeister** from assistant secretary, a position he has held for several years, to secretary. Mr. Myers succeeds as treasurer **H. E. Freeman,** who has retired, though he will continue as one of the directors.

Obituary

Charles H. Nicholson, inspector of wires in the city of Malden, Mass., for the past fifteen years, died in Malden July 27. He was a native of Newton, Mass., and was 53 years of age.

William R. Schmidley, formerly district manager of the Wisconsin Power & Light Company, with headquarters at Janesville, died at his home in Madison on July 4. When the new gas light company of Janesville was consolidated with the Wisconsin Power & Light Company, Mr. Schmidley was transferred to Madison. He was last employed in the district engineering department. Mr. Schmidley was a graduate of the University of Wisconsin and since 1920 was identified with various utility companies in Wisconsin.

Financial and Statistical

Utility Market Moves Up
Bonds in Keener Demand
July Financing Low

PLUSES were greatly in the majority in the market lists of public utility securities this week. Several new high prices were registered, especially among common stocks. The ELECTRICAL WORLD index of power and light common stocks is close to the high point for the year reached early in June. Among the more substantial gains were the common stocks of American Gas & Electric, Brooklyn Edison, Columbia Gas & Electric, Metropolitan Edison and Public Service Corporation of New Jersey. More life is evident in the public utility bond market than has been the case for some time. The volume of trading this week has been fairly heavy.

Public financing of the power and light companies, details of which are published in this issue, was unusually light during July. The total for all classes was $80,997,000, against $107,476,000 for July of last year and a monthly average this year to date of $125,244,000. The first half year's financing, it will be recalled, was unusually heavy, exceeding that of the corresponding period of 1926 by almost 10 per cent. Some very substantial issues are now being made ready for sale and will be brought out shortly.

Southeastern Power's Growth Facilitates Industrialization

The Southeastern Power & Light Company's current construction program and rapid growth affords one of the nation's best examples of the investment potentialities as well as the national importance of the large power groups. The interests of the shareholders are naturally of first importance. Yet in developing a policy that will best serve the interests of this group service to the customers and to the community must necessarily be paramount. Southeastern is a more and more important factor in the industrialization of a huge area of the South, and the present expansion policy is directed to taking care of this need. The company has recently stated that the policy of expansion within its territory is practically completed, and the program of the immediate future is to make the system more compact by extending service to small adjacent communities as well as increasing energy output to meet a rapidly increasing demand.

Last year the company's output exceeded that of the year before by 65 per cent, while both gross and net earnings more than doubled over 1925. Last year's earnings amounted to $1.96 a share as compared with 45 cents in 1925. Recent expansion in capacity has made the earning power of the group materially greater than before. The common stock of the company was placed on a one-dollar dividend basis last March by the payment of an initial dividend of 25 cents a share. This is a yield of less than 3 per cent at the present price of the stock. The parent company owns all of the common stock of its subsidiaries as well as a substantial amount of the preferred.

While the outstanding feature of the progress made by the company in 1926 was undoubtedly the expansion in plant and equipment, which increased the generating capacity by 210,000 kva., the period was an important one also as a year of consolidations within the system. As a result of these consolidations the system is better co-ordinated than ever before. There are now seven main subsidiaries, serving a territory which extends from Charleston, S. C., on the east to central Mississippi on the west and from the southern border of Tennessee to the Gulf Coast, an area of nearly 150,000 square miles, containing a population of approximately 5,000,000.

Utilities' Versus Railroad Credit

Public Service Companies Are Building Financial Structures with More Substantial Equity Bases than Those of Railroads—Will Make Borrowing Easier

BY H. C. HOPSON
Vice-President Associated Gas & Electric Company

TAKING issue with the statement made in a recent number of the *Electrical World* that the power and light industry "has established a credit position in the money markets second to that of no other industry," H. C. Hopson, vice-president of the Associated Gas & Electric Company and formerly a member of the New York State Public Service Commission, the Wisconsin Tax Commission and the Interstate Commerce Commission, compares the credit position of these utilities with that of the railroads.

On the basis of bond issues only, recent records bear out the statement made in the editorial, and the 1 per cent differential mentioned by Mr. Hopson is largely due to the difference in financing methods prevalent in the two industries. The railroads rely wholly upon bond issues, while the utilities rely upon balanced issues of securities. The reasons for this difference in financial policy are outlined ably by Mr. Hopson.—*Editors.*

IN VIEW of the fact that all of the statistics with which I am familiar show that the average yield of money on railroad bond issues is nearly 1 per cent below that of the average yield on electric and gas company interest-bearing securities, I do not see how any one can say with accuracy that the credit of the light and power industry is second to that of no other industry.

On reading the article entitled "First Half Year's Financing Exceeds That of Last Year," in the July 2 issue of the ELECTRICAL WORLD, I desire to take exception to the concluding statement of the article, which reads: "These figures indicate that the light and power industry has established a credit position in the money markets second to that of no other industry." My observations in this respect are somewhat to the contrary, for I have found that, in spite of the increasing confidence of the public in the stability and earning power of electric and gas companies and the growing demand for their securities arising from this confidence, the cost of financing them has been higher than the cost of financing certain other industries, notably the railroads.

Your paper is, and many others are, continually pointing out that the sale of stock by light and power companies is proof that they have better credit, apparently assuming without sufficient reflection that the railroads could not sell stock if they tried to. I do not believe that this assumption is correct. In my opinion, the only reason the railroads do not sell stock is because of a lack of desire on the part of those in control of their policies, whereas those in control of the gas and electric companies are insistent upon maintaining more evenly balanced capital structures.

While the sale of stocks or bonds by gas and electric utilities is a matter of cause and effect, the cause is not, as it seems to be generally assumed, dictated by the ability in the one case and lack of it in another, but is purely due to policies of management. If this were not so, railroad bonds would not be marketed so generally and stock so infrequently simply because bonds can be marketed to such an apparent advantage. The real cause and effect as to these matters brings up an entirely separate and collateral situation which,

I believe, you will agree, when once considered, demonstrates that the statement just made is correct.

OWNERSHIP AND MANAGEMENT DIVORCED

With few exceptions, the ownership and management of the important railroads is vested in two entirely different groups. Ownership is spread among thousands of people; in very few cases does any individual or small group of individuals control. Management is by hired experts, and its function is to make as good a showing as it can. Its successes find expression in standard terms of "new territory developed," "new lines built," "increase in gross," "car movement," etc., and the scattered owners think of the records with pride, if they think of them at all. All of these call for further investment in right-of-way, equipment, etc., and funds must be provided. Not having the owner's viewpoint, the managements borrow the money necessary to finance the capital investment as cheaply as possible and regard this also as an accomplishment. In this they are guided perhaps by the advice of bankers who know that there is a practically insatiable investment demand for the bonds of carriers which were flourishing before the electrical industry came into being. It never seems to occur to the owners that in the process their equity and margin of safety has been lessened.

No criticism of any phase of this matter is intended. The management properly knows that it is to be judged and rewarded in accordance with its accomplishments during its lifetime. The bankers know that the sale *en bloc* of the stock of existing enterprises is fraught with difficulty and with risk wholly out of proportion to the compensation to be obtained. Senior securities of carriers a century old—many of them legal investments for savings banks and trust funds—find a ready market upon a favorable basis. The whole arrangement has become tradition, including the lack of interest displayed by the scattered owners. It is true, however, in my judgment, that out of the adherence to this tradition grew the Santa Fe receivership in the previous generation, the New Haven of a decade ago, the Grand Trunk Pacific and the Western Pacific Extension of half a decade past, and the final rumblings of the St. Paul receivership, which are still being heard.

The gas and electric companies present a different picture. Five out of six of the larger utilities which come to my mind at the moment are respectively owned and managed by identical interests. Being owners as well as managers, the management does not seek low-priced financing in the interest of management if it is detrimental to the interests of the stockholders. Therefore, we find that a large part of the power and light company financing is done through the sale of stock. It is true that the issuance of such securities calls for a higher rate than would the issue of bonds, but, on the other hand, it does not saddle the particular company with tremendous fixed charges which decrease the portion of the earnings applicable to the common and preferred stocks and which might threaten insolvency in times of depression.

The gas and electric industry appears to pay a higher price for money than the railroads and will continue to do so for some time, but ultimately its credit (if by that is meant borrowing capacity) will be far better than that of the railroads because it is rearing a sounder corporate structure, fewer interest-bearing securities being issued, and also because ultimately the investing public will recognize that the nature of its business makes its securities a more secure investment than is inherently true of the securities of the railroads.

The seasonal fluctuation of the business of the power and light companies is no greater than that of the railroads, and the year-to-year fluctuations of the business of the public utilities are much less than that of the railroad industry. Furthermore, while the railroads are engaged in a life and death competition with other forms of transportation, the power and light companies are furnishing a service the demand for which is increasing at a tremendous rate, with practically no competition from other agencies. Undoubtedly the railroad industry is more closely tied to the ups and downs of business depression than is the public utility industry. In other words, the public utilities are more intimately engaged in serving the day-to-day requirements of the public than are the railroads.

The public utility industry is, of course, more monopolistic than the railroad industry so far as the service rendered is concerned. Both, however, are competing for capital not only with each other but with all other users of capital. Each is endeavoring to secure the money it requires for additions and improvements of plant at the lowest possible cost, and there are millions of dollars' worth of improvements which can be justified by any large industry, if the cost of money or capital to finance them can be reduced even only a fraction of 1 per cent.

Summarizing what I have said, therefore, the railroads still appear to enjoy better credit with investors than do the power and light companies, even though, in my judgment, they do not deserve to. Your article says: "These figures indicate that the light and power industry has established a credit position in the money markets second to that of no other industry." Much as I believe that this should be so and that it ultimately will be so, my judgment tells me that the time has not yet arrived to assert it as a present fact.

Security Issues of Electric Service Companies in July

Name of Company	Amount of Issue (Par Value)	Period Years	Class	Purpose	Interest Rate	Price	Per Cent Yield
Pennsylvania-Ohio Power & Light Co.	$3,447,500	..	Cumulative preferred stock	To retire stock	6	98½	6.09
Western Power, Light & Telephone Co.	1,000,000	2	Gold notes	To acquire stock ownership of certain companies, to retire bonds, to provide additional working capital and for other corporate purposes	6	100	6
Springfield Gas & Electric Co.	3,600,000	30	First mortgage gold bonds, series A	Acquisition of property	5	97½	5.15
Carolina Power & Light Co.	10,000,000	29	First and refunding mortgage gold bonds	To reimburse for additions to property, to raise funds for construction and for other corporate purposes	5	100¾	4.95
American Water Works & Elec. Co	19,800,000	..	First preferred stock, cumulative	To redeem stock, acquisitions and for other corporate purposes	6	99	6.06
General Power & Light Co.	1,750,000	½	Secured gold notes	To retire maturing obligations and for other corporate purposes	5	99½	6
Texas-Gulf Power Co.	900,000	1	Gold notes	Acquisition of properties, for transmission line extensions and other capital purposes	5	99	6
Detroit Edison Co.	20,000,000	35	General and refunding mortgage gold bonds, series C	To reimburse for expenditures made for improvements	5	102¼	4.85
Union Electric Light & Power Co.	10,000,000	40	General mortgage gold bonds, series B	To reimburse the company for expenditures made for additions and extensions	5	102½	4.85
Public Service Co. of No. Illinois	10,000,000	5	Debentures	To reimburse for expenditures on extensions and additions	5	99	5.20
Indiana Electric Corp.*	.....	24	First mortgage and refunding gold bonds, series C	.....	5	97	5.22
Southern Nebraska Power Co.	500,000	20	First mortgage gold bonds, series B	To retire securities, to reimburse for additions and for other corporate purposes	5¼	98	5.66
Total amount of issues	$80,997,500 (par value)						
Total amount actually realized	$81,305,037						

Accuracy in Announcing New Issues Urged

Public Service Securities Committee of Investment Bankers' Association Issues Annual Report

VARIOUS factors relating to capitalization and to the legalization of additional classes of securities for investment purposes are discussed in the annual report of the public service securities committee of the Investment Bankers' Association of America, of which Joseph L. Seybold of Minneapolis is chairman. Some strong recommendations with regard to the issue of securities are urged upon members of the association.

Special attention was given by the committee to a proposed uniform law for the regulation of utilities which it is expected will be brought before the National Conference of Commissioners on Uniform State Laws in August of this year. Subject to certain possible changes and omissions, the committee approves in principle the latest draft submitted. This draft provides that a state regulating commission may establish a system of accounts to be kept by the public utilities subject to its jurisdiction or may classify said public utilities and establish a system of accounts for each class and prescribe the manner in which such accounts shall be kept. The draft further provides that the commission may require the filing of annual reports in such form and of such contents as may be prescribed by the commission.

The legalizing of public utility bonds for savings bank and trust company investment came in for much attention from the investment bankers' committee. A study was made of the New York situation where bills prepared for the purpose failed to pass. A resolution was passed calling for the appointment of a legislative committee to investigate the necessity of revising the savings bank investment law of that state. The Minnesota Legislature has amended its statute to permit savings-bank investment in certain utility bonds. The provisions are conservative but sufficiently broad to permit the purchase of the better-grade issues.

After drawing attention to the outstanding decisions of the year, such as those in the Indianapolis Water Company case and the Laclede Gas Light Company case, the report sums up in part as follows:

"Regulation of practices of any industry which proceeds from thoroughly informed sources, either within or associated with the industry itself, is to be preferred over one imposed by governmental authority, which experience has shown to be uneconomical in many respects. However, unless such inner regulation of practice prevents flagrant abuses, there is always a danger of agitation for government supervision. While any such agitation might result from and be directed at the abuses in particular cases, it could hardly help affecting, in a measure at least, the soundly conceived enterprises in the industry and the thousands of investors, many of them people of small means, who have invested in their securities. It is, therefore, to the interest not only of the leaders in the public utility industry itself, but also to the bankers who sell their securities, to direct all possible influence for removing or preventing any just cause for criticism.

"A form of protection against criticism for the soundly conceived enterprise of the industry has already been suggested by this association. We refer to the emphasis which is now being placed on the publishing of adequate information in the offering of securities. The effect of such work as the association has already done along these lines seems to be making itself felt. The circulars received by this committee so far this year represent in the main reasonably fair presentations of the securities offered. Such criticism as might possibly be made is not serious, but we note that the difficulties of securing adequate information are more pronounced in connection with holding-company securities than in the case of operating companies. In view of the prevalent discussions of the holding companies, this committee again urges all members of the association to give especially careful thought to the preparation of circulars offering such securities, to the end that no reasonable criticism can be made on the basis of inadequate or misleading information. In preparing circulars it should be borne in mind that sales information is prepared for and used by investors, who in many cases are without the background or collateral information enjoyed by the banker. For that reason the subject matter should be presented in greater detail, even at the risk of seeming unnecessarily full to the informed buyer."

New Three-Million-Dollar Offering Made

First lien 5 per cent gold bonds of the Southwestern Power & Light Company were offered this week to the amount of $3,000,000, the price being 99 and accrued interest, to yield about 5.10 per cent. These bonds, dated June 1, 1913, and maturing June 1, 1943, are secured by all outstanding stocks (except directors' qualifying shares) and bonds of six subsidiary companies.

Electricity Supply in Paris

At the recent annual meeting of the Compagnie Parisienne de Distributions d'Electricité, the chairman, according to a foreign correspondent, gave some interesting particulars of the progress of the demand for electricity for lighting and power purposes in the French capital. Thus he stated that during last year there was an increase of 66,538, or 13 per cent, in the number of consumers, bringing up the total to 577,592. The increase in consumption was, however, not so great, amounting only to 33,000,000 kw.-hr., or about 8 per cent, the quantity supplied having advanced from 412,696,535 kw.-hr. in 1925 to 445,000,000 kw.-hr. in 1926. Plans are in progress for increasing the capacity of the power stations at St. Ouen and Issy-les-Moulineaux to 450,000 kw., which, it is anticipated, will meet the requirements of Paris until the end of 1935. Schemes for increasing the supply after that year are already under consideration.

Southern California Issue

Retirement of its $26,500,000 issue of refunding bonds is given as the purpose of a $35,000,000 5 per cent issue which the Southern California Edison Company is expected to sell in the near future. This issue is typical of the policy which many companies are following, of taking advantage of the favorable money market for retiring higher-priced issues.

Electricity Supply in the Argentine Republic

Some interesting particulars anent the progress of electricity supply in Buenos Aires are given in the recently issued report of the Compañia Hispano-Americana de Electricidad. The quantity of energy supplied during last year for various purposes as compared with 1925, together with the percentage increases, is shown in the accompanying table.

OUTPUT OF ENERGY IN BUENOS AIRES IN 1925 AND 1926

	Kw.-Hr. 1926	Kw.-Hr. 1925	Per Cent Increase
Private lighting	141,012,141	131,747,038	7.03
Public lighting	20,871,054	19,518,721	6.93
Power purposes	125,753,505	91,814,712	36.96
Tramway operation	86,993,173	86,034,774	1.11
Other purposes	62,935,801	80,035,478	*2.36
Company's own supply	13,170,287	12,153,085	8.37
Totals	450,735,961	421,303,808	6.99

* Decrease.

The increases in the various categories show considerable fluctuation, the biggest advance being in the demand for electricity for power purposes. The great progress of electrical consumption in Buenos Aires is indicated by the fact that since 1917 the annual sales have advanced from 185,253,820 kw.-hr. to 450,735,961 kw.-hr. The maximum load on the generating plant now amounts to 624,282 kw., an increase of 49,833 kw. over 1925. The power stations of the company now have a total capacity of 227,620 kw., two new 25,000-hp. steam turbines and generators having been completed during the past year at the Central Dock Sud station, where also two 25,000-hp. sets were put to work in January and April last respectively. During the year the length of the company's distributing system was extended from 4,354 to 4,662 miles. Pending the completion of the new superpower station in Buenos Aires, which will not be ready until 1929, two further 42,500-hp. units have been ordered for the Dock Sud plant and are to be ready for work next year. They will eventually be transferred to the superstation.

Cambridge Company Asks Ruling on Rate-Base Determination

Requests to the Massachusetts Department of Public Utilities for rulings upon fourteen points related to rate-base determination in connection with the pending decision of the board upon the price of electricity supplied to consumers have been filed by the Cambridge Electric Light Company. As in the recent Worcester case, the company is seeking to establish a rate base upon the reproduction-cost-less-depreciation theory as against the so-called Massachusetts invested-capital practice. The requests for rulings, which set forth the company's position in rate-basing practice, were filed by its counsel, R. G. Dodge and J. M. Raymond, and follow:

1. This company is entitled to earn a reasonable return upon the fair value of its property at the present time, and this fair value is not to be measured by the amount of capital invested in the property.

2. The principles to be applied in the regulation of the rates of this company are those which have been laid down by the Supreme Court of the United States.

3. The rights of this company with respect to rate regulation are identical with those of companies outside the state and are to be measured and governed by the same rules.

4. In determining present value consideration must be given to prices and wages prevailing at the present time and likely to prevail during a reasonable period in the immediate future.

5. If the tendency or trend of prices is not definitely upward or downward and it does not appear probable that there will be a substantial change of prices, then the present value of lands plus the present cost of constructing the plant, less depreciation, is a fair measure of value of the physical elements of the property.

6. For the purpose of rate regulation the value of a property like that of this company, while not varying with minor fluctuations in the prices of material and labor required to produce, follows in general the relatively permanent levels and trends of such prices.

7. The issues raised by the present petition cannot be decided without determining in the first instances the rate base, that is to say, the fair present value of the property upon which the company is entitled to earn a return.

8. The fact that the company's charter is subject to repeal is immaterial in these proceedings.

9. If the company's locations in the highways are subject to revocation, that fact is immaterial in the present proceedings.

10. In determining the value of the company's property for the purposes of rate regulation, there must be included an allowance for going value, that is to say, that element of value which inheres in an assembled and established plant, doing business and earning money over one not thus established.

11. In determining the rate base there must be a reasonable allowance for organization and other overhead charges that would be incurred in reproducing the plant, and the amount is not dependent on proof of actual expenditures.

12. For the purposes of rate regulation it is immaterial that the company's property has been paid for to a considerable extent out of earnings rather than from the proceeds of the sale of capital stock, and the property is to be valued without reference to this fact.

13. There is no evidence in this case to justify a finding that the tendency or trend of the prices of labor and material required in the construction of a property like that of this company is definitely downward.

14. A company which is managed prudently and economically administered, alive to the public requirements and furnishing satisfactory service at a low rate in comparison with other companies, is entitled to earn a higher rate of return upon the value of its property than is a company not possessing these qualities.

American Water Works & Electric Company of Delaware Incorporated.—A certificate has been filed in the office of the Secretary of State of New York dissolving the corporate existence of the American Water Works & Electric Company, Incorporated, a New York State corporation, and simultaneously there was filed a certificate of statement and designation of the American Water Works & Electric Company, Incorporated, chartered under Delaware laws to perform the functions of a holding company dealing in stocks, bonds and securities of electric companies and

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday Aug. 2	Low 1927	High 1927
ABITIBI PWR. & PAPER, 4%			
com.—no par	101⅛	83	102½
Adirondack Pwr. & Lt.—7% pf.	112	107	113½
Adirondack Pwr. & Lt.—8% pf.	113	112	116
Ala. Pwr., $7 cum. pf.—no par	110	107	114
Allis-Chalmers Mfg., 7% pf.	111⅛	109	112½
Allis-Chalmers Mfg., 6% com.	109	88	111½
Aluminum Co. of Amer., com.	91½	67⅛	105
Aluminum Co. of Amer., 6% of	k102½	101⅛	104½
Amer. & Foreign Pwr., pf. 25% pd.	m110	....	....
Amer. & Foreign Pwr., 7% pf.—no par	100½	86½	102
Amer. & Foreign Pwr., com.—no par.	22⅛	18½	25½
Amer. Bosch Magneto, com.—no par	20½	13	22⅜
Amer. Brown Boveri Elec†	12½	10½	39½
Amer. Brown Boveri Elec., pf. $7	56½	50	98
Amer. Gas & Elec., 6% pf.—no par	101½	95½	105½
Amer. Gas & Elec., com.†—no par	96⅛	68⅛	100½
Amer. Lt. & Trac., 6% pf.	116	112	120
Amer. Lt. & Trac., new com.	165	165	178½
Amer. Pwr. & Lt., 6% pf.	103½	97½	106½
Amer. Pwr. & Lt., com.†—no par	62½	54	67
Amer. Pub. Serv., 7% pf.	k 98	95	99½
Amer. Pub. Serv., com.†	65	....	....
Amer. Pub. Utilities, 7% ptc. pf	a85½	73	88½
Amer. Pub. Utilities, 7% pr. pf.	a 92½	92	96
Amer. Pub. Utilities, com.	k56	65	70
Amer. States Sec., A	3	2½	4½
Amer. States Sec., B	3	2½	4½
Amer. Superpwr., 6% ptc pf.—25Ex. div.	29½	26½	29½
Amer. Superpwr., 6% 1st pf.	i 98	....	....
Amer. Superpwr., Class A†—no par.	36	27½	38½
Amer. Superpwr., Class B†—no par.	36½	28½	39½
Amer. Wtr. Wks. & Elec., 7% pf.	k111½	104½	111½
Amer. W. W. & E., com. $1.60—20.	95	62½	98
Anaconda Copper cap. $3	46½	41½	49½
Appalachian Electric Pwr., 7% pf.	102	100	105
Appalachian Elec. Pwr., 7% 2nd pf.	101	100	102
Appalachian Elec. Pwr., com.	m78	....	....
Arizona Pwr., 7% pf.	k78	77	84½
Arizona Pwr., com.	m 20⅞	....	....
Arkansas Pwr. & Lt. 7% pf.	100	....	....
Assoc. Gas & Elec., $3.50—50	51	....	....
Assoc. Gas & Elec., pf.—$6—no par.	92	85	93
Assoc. G. & E., Class A, 10—no par.	40½	35	43
BABCOCK & WILCOX, 7% com.	115	113	124
Binghamton L., H. & P., $6 pf.	97	93	98
Birmingham Elec., pf.—$7—no par.	108	105	109
Blackstone Valley G. & E., 6% pf.	106	103	105
Blackstone Valley Gas & Elec., 10% com.—50	k135	98	153
Blaw-Knox, com.†	i 74	70	75
Brazilian Trac., Lt. & pwr., com.†	f170½	....	....
Broad River Pwr., 7% pf.	100	97	103
Brooklyn Edison, 8% com.	175	148½	176½
Buffalo, Niagara & East. Pwr., $1.60 pf.—25	i 25½	....	....
Buffalo, Niagara & East. Pwr. com. $1—no par	i 32½	....	....
CALIFORNIA ELEC. GENERATING, 6% pf.	96½	96	99½
California Ry. & Pwr., 7% pf.	135	125	150
Carolina Pwr. & Lt., pf.—$7—no par	f109	107	109
Central & S.W. Util., $7 pf.—no par	a 96½	93½	97½
Central & S.W. Util., pr ln. $7 pf.—no par	a103	98½	104½
Central Ariz. Lt. & Pwr., 8% pf.	k 97	95	98
Central Ark. Ry. & Lt., 7% pf.	106	100	104
Central Ill. Pub. Serv., $6 pf.	a 91½	88½	95½
Central Ind. Pwr., 7% pf.	92½	86	95
Central Pwr. & Lt., 7% pf.	101	100½	103
Central States Elec., 7% pf.	94	93	96
Central States Elec., com.†	m200	....	....
Century Elec., 6% com.	m115	115	115
Chicago Fuse Mfg., com.—$2.50 no par	a 35	30	35
Cincinnati Gas & Elec., 5% com.	g 99½	96½	99
Cities Service, 6% pf.	i 87⅛	87⅛	87⅛
Cities Service, pf. B—10	i 8	7⅛	8½
Cities Service, pf. BB—100	i 82	81	85
Cities Service, com.—20	i 45⅛	45⅛	45⅛
Cities Service, Bks. Shrs.—10	i 22½	23	29½
Clarion River Pwr., 8% pf.	95	....	....
Cleveland Elec. Illg., 6% pf.	110½	108	112
Cleveland Elec. Illg., 10% com.	295	285	330
Columbia Gas & Elec., 6% pf.	106	99½	107½
Columbia G. & E. com. $5—no par	95½	82½	98⅛
Columbia Ry., Gas & Elec., 6% pf.	m106	....	....
Columbus Elec. & Pwr., $2 com.—no par	70	....	....
Columbus Ry., Pwr. & Lt., 6%, 1st pf.	102	98½	102½
Columbus Ry., Pwr. & Lt., 6½% pf. B	101	96	103½
Columbus Ry., P. & L., com.—no par	100	75	105
Commonwealth Edison, 8% com.	a152½	138	155
Commonwealth Pwr., 6% pf.	99½	91½	100
Commonw'th Pwr., $2, com.—no par	53½	48½	54½
Conn. Lt. & Pwr., 8% pf.	121	119	123
Conn. Lt. & Pwr., 7% pf.	117	112	118
Cons. Gas of N. Y., pf.	98½	93	98
Cons. Gas of N. Y., com $5—no par.	112	94	112½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	k105	105	107
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½ pf.	e112½	110½	112½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 7% pf.	e115½	112½	115½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 8% pf.	e128	127	129½
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $2.50—no par.	e 60	51	62
Consolidated Pwr. & Lt., 7% pf.	105	100	106
Consumers Pwr., 6% pf.	101½	100	102
Consumers Pwr., 6.6% pf.	105	103	105½
Continental Gas & Elec., 8% ptc. pf.	106	103	106½
Continental Gas & Elec., 7% pr. pf.	105½	100	103
Conti. G. & E. com. $4.40—no par.	200	210	225
Crocker Wheeler, com.†	k27	30	38
Crocker Wheeler, 7% pf.	k84	78	88
DALLAS PWR. & LT., 7% pf.	109	107	110½
Dayton Pwr. & Lt., 6% pf.	109	101	107
Detroit Edison, 8% com.	149	133½	157
Dubilier Condenser, com.—no par.	k4	3½	5½
Duquesne Lt., 7% pf.	116½	114½	116½
EASTERN NEW YORK UTIL., $7 pf.	105	102	104½
Eastern New York Util. com.	65	70	75
Eastern States Pwr., $7, com.	9	9	13
Eastern States Pwr., pf.	90	90	95
East. Tex. Elec., 7% pf.	106	106	108
Edison Elec. of Boston, $12 com.	d242½	217	267
El Paso Elec., 7% pf.	108	105	107½
Elec. Bond & Share, 6% pf.	l108½	105½	109
Elec. Bd. & Sh. Sec. †com. $1—no par	i 74½	67⅛	79½
Electric Household Util.†	a 12½	11	15½
Elec. Investors, 6% pf.—no par	95	92	96½
Elec. Investors, com.†—no par	37½	32½	40½
Elec. Investors, 10% pd. receipts	m 15	....	....
Elec. Pwr. & Lt., ctfs. pf.	104	96	106½
Elec. Pwr. & Lt., ctfs., 40% pd.	114	103½	115
Elec. Pwr. & Lt., ctfs. full pd.	m114	108½	111½
Elec. Pwr. & Lt., ctfs., com.—no par.	23½	16½	23⅜
Elec. Refrig. cap.†	15½	12½	37½
Elec. Ry. Securities, com.—no par.	7	....	....
Elec. St. Battery com. $5.25—no par	69½	63½	79½
Elmira Wtr., Lt. & R.R., 7% pf.	101	99	101½
Emerson Elec., pf.	m109	107½	111
Empire Pwr., pte.†	35½	26	39
Engr. Pub. Serv., $7 pf.—no par.	104	93½	106½
Engr. Pub. Serv., com.—no par	29½	21½	29½
Eureka Vacuum Cleaner, com. $4—no par	72½	60½	74½
FAIRBANKS MORSE, 7% pf.	k108	107½	112
F.-M., com.—$3—no par.	39½	37½	43½
Federal Lt. & Trac., com. $1.40	43	37½	47
Federal Lt. & Trac., $6 pf.—no par.	98½	91½	99½
Ft. Worth Pwr. & Lt., 7% pf.	l110	108	112
GALVESTON-HOUSTON ELEC. 6% pf.	70	68	72
Galveston-Houston Elec., com.	26	28	32
Gen. Elec., $3 com.—no par.	131	81	131
Gen. Elec., special—6%	11⅛	11	11⅛
Gen. Gas & Elec. (Del.) com. A, $1.50—no par	40	34	47½
Gen. G.&E. (Del.) com. B—no par.	44½	35½	44½
Gen. G.&E. (Del.) pf. A. $8—no par.	k117½	113½	120
Gen. G.&E. (Del.) pf. A $7—no par.	k108	100	109½
Gen G.& E. (Del.) pf. B $7	k103½	96	105
Gen. Pub. Serv., $7 cum. pf., no par.	k107	102	106
Gen. Pub. Serv., com., no par	13½	11½	15
Ga. Lt., Pwr. & Rys., 6% pf.	92	87	96
Ga. Lt., Pwr., & Rys., com.	m 45	....	....
Ga. Ry. & Pwr., 8% pf.	k123	119	125
Ga. Ry. & Pwr., 7% pf.	k113	106	110
Gt. Western Pwr., 7% pf.	k103	....	....
IDAHO PWR., 7% pf.	107½	103	109
Ill. No. Utilities, 6% pf.	a 97	92	97
Ill. Pwr. & Lt., 7% pf.	101	99	101
Ingersoll Rand com. $8	k 92	88½	96½
Int. Combus. Engr., com. $2—no par	48⅛	43½	64
Int. Util., Class A—$3.50—no par ex. div.	38½	28	41
Int. Utilities, Class B—no par.	5½	3	7
Interstate Pwr., pf.—$7—no par.	94	93	98
Interstate Pub. Serv., 7% pf.	99	98	99½
Iowa Ry. & Lt., 7% pf.	97½	97	99
JERSEY CENTRAL PWR. & LT. CO., 7% pf.	101½	97½	103
Johns-Manville, com.†—no par.	89	55½	89

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; fMontreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, July 30 lBid price Wednesday Aug. 3. mLatest quotations available. †Dividend rate variable.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday Aug. 2	Low 1927	High 1927
KANSAS CITY PWR. & LT. pf.$7	k113	112	115½
Kansas Gas & Elec., 7% pf.	l105	103	107
Kentucky Hydro-Elec., 7% pf.	a 97	94½	97½
Kentucky Sec., 6% pf.	86	83	87
Kentucky Sec., 5% com.	109	110	115
Kentucky Utilities, 6% pf.	99	95	98½
LACLEDE GAS LT., 12% com.	240	173½	267½
Lehigh Pwr. Sec., com.—no par.	18½	15	20
Long Island Ltg., 7% pf.	109	107	112
Long Island Ltg., com.†—no par	135	139	153
Los Angeles Gas & Elec., 6% pf.	k106	98	104
Louisville Gas & Elec., cl. A. $1.75	27	23½	27½
MAN. ELEC. SUPPLY, cap. $5—no par	131	53½	131
Manila Elec., com.†—no par	k 42½	40	46
Maytag Mfg., com. .50—no par	30½	23½	32½
Memphis P. & L., pf.—$7—no par	108	107	109
Metropolitan Ed., pf.—$6—no par	k99	93	100
Metropolitan Ed., pf.—$7—no par	108	104	108
Metropolitan Ed., com. $5—no par	70	60	72
Middle West Utilities, 7% pf.	a111	105½	113½
Middle West Util., 8% pr. lien	a121	117½	122½
Middle West Util., com. $6—no par ex. div.	a111	108	117½
Midland Utilities, pr. in. 7% pf.	a104	92½	104½
Midland Utilities, 7% pf. A	a101	98	106
Milwaukee Elec. Ry. & Lt., 7% pf.	k102	100	103
Milwaukee Elec. Ry. & Lt., 6% pf.	k 98	98	101½
Minn. Pwr. & Lt., 7% pf.	l105½	104	107
Miss. Pwr. & Lt., $8 pf.	m101	106	103
Miss. River Pwr., 8% pf.	102	94	103
Miss. River Pwr. 3% com.	62	....	....
Mohawk Hudson Pwr., 1st pf.—$7—no par.	105	100	109
Mohawk Hudson Pwr., 2d pf.—$7—no par.	104	98	112
Mohawk Hudson Pwr., com.—no par	24½	20½	27
Montana Pwr., 7% pf.	m106½	118½	106½
Montana Pwr., 5% com.	105½	81½	106½
Montreal Pwr., 7% com.	f 84	....	....
Mountain States Pwr., 7% pf.	99½	97	101
Mountain States pwr., com.†	18	....	....
NASSAU & SUFFOLK LTG., 7% pf.	106½	98	105
National Carbon, 8% pf.	a137	130½	137½
National Elec. Pwr., A†	a 25	23½	25½
National Lt., Ht. & Pwr., com.	24	....	....
National, Light, Ht. & Pwr., 5% pf.	70	....	....
National Pwr. & Lt., pf.—$7—no par	106	101	108½
National Pwr. & Lt., com.†—no par.	21½	19½	23½
National Pub. Serv., 7% pf.	97	93	100
National Pub. Serv., 7% pfc., pf.	113	108	115
National Pub. Serv., A com. $1.60—no par	22½	18½	24
National Pub. Serv., B com.—no par	k 17½	14	20½
Nebraska Pwr., 7% pf.	l109	106	109
Nevada-Calif. Elec., com.	m 26½	25	31
New Brunswick Pwr., 4% pf.	55	....	....
New Eng. Pub. Serv., pr. in. pf. $7..	100	98½	101
New Eng. Pub. Serv. pf. $7	96	95	97½
New Orleans Pub. Serv.—7% pf.	103	103	105½
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	90	91	97
N. Y. Central Elec., 7% pf.	101	102	104
Newport News & Hampton Ry., Gas & Elec., 5% com.	109	....	....
Newport News & Hampton Ry., Gas & Elec., 7% pf.	109	....	....
Niagara Falls Pwr., 7% pf.—25....	k 28½	27½	29½
Niagara, Lock. & Ont. Pwr., 7% pf.	111	110½	113
No. Amer., 6% pf.—50.	52½	50	52½
No. Amer., com.—10	50½	45½	52½
No. Amer. Edison, $6 pf.—no par....	101½	96½	101½
No. Caro. Pub. Serv., pf.—$7—no par	101	93	102½
Northeastern Pwr., com.	18	14½	20½
No. N. Y. Utilities, 7% pf.	101	103	109
No. Ohio Pwr., com.—no par.	12½	9½	13½
No. Ohio Pwr. & Lt., 6% pf.	82½	78	81
No. Ohio Pwr. & Lt., 7% pf.	93½	90	93
No. Ont. Lt. & Pwr., 6% pf.	k 91	84	95
No. Ont. Lt. & Pwr., 4% com.	72	73	78
No. States Pwr., (Del.) 7% pf.	104	101	107½
No. States Pwr., (Del.) 8% com.	121½	109½	124
No. Texas Elec., 6% pf.	62	65	70
No. Texas Elec., com.	22	27	36
OHIO BRASS, com. B $4—no par.	82	74	85
Ohio Brass, 6% pf.	105	100	105
Ohio Pwr., 6% pf.	101½	96	103
Ohio Pub. Serv., $6 pf.	98	95	96½
Ohio Pub. Serv., 7% pf.	106	103	109
Ohio River Edison, 7% pf.	108½	103	109½
Oklahoma Gas & Elec., 7% pf.	105½	....	....
PACIFIC GAS & ELEC., 6% pf.	26½	24½	26½
Pacific Gas & Elec., 8% new com.	k 37½	31	39½
Pacific Pwr. & Lt., 7% pf.	l104	102	104
Penn Cent. Lt. & Pwr., $5 pf.—no par	c 75½	71½	76½
Penn-Ohio Edison, 7% pf.	101½	97½	104½
Penn-Ohio Elec., 7% pf.	99	98	100
Penn-Ohio Pwr. & Lt., 7% pf.	101	99	103
Penn Pwr. & Lt.—$7—no par.	l108½	107	108½
Penn Wtr. & Pwr., 8% com., new	c 55½	47½	55½
Phila. Co., 6% pf.—50.	52½	50	53
Phila. Co., com.—50.	k 105	85½	110
Phila. Elec., 8% com.—25.	c 52½	46½	54
Portland Elec. Pwr., 7% pf.	98	97½	101
Portland Elec. Pwr., 6% pf.	79	78	83
Portland Elec. Pwr., 6% 2d pf.	60	55	70
Portland Elec. Pwr., com.	25	22	30
Potomac Elec. Pwr., 6% pf.	j108½	....	....
Pwr. Corp. of N. Y., com. $1—no par	m 79	....	....
Pwr. Sec., pf.—no par.	k 28	28	33
Pwr. Sec., com.—no par.	k 6	5	8
Public Serv. of Colorado, 7% pf.	l102	....	....
Pub. Serv. of N. J., 6% pf.	101	98½	101½
Pub. Serv. of N. J., 8% pf.	k130½	125	132
P. S. of N. J., $2 com.—no par.	43½	32	45½
Pub. Serv. of No. Ill., 6% pf.	a105½	101½	105½
Pub. Serv. of No. Ill., 7% pf.	a116	112½	117
P. S. of No. Ill., com. $8—no par	a140½	130½	143
Pub. Serv. of No. Ill., $8 com.	a140	132	142
Pub. Serv. of Okla., 7% pr. in.	100	99	100½
Pub. Serv. Elec. & Gas, 6% pf	k107	102	108½
Puget Sound Pwr. & Lt., 7% pr. pf.	106½	105	107
Puget Sound Pwr. & Lt., $6 pf.—no par.	88	....	....
Puget Sound Pwr. & Lt., com.	33	28	35½
RADIO CORP. OF AMER., $3.50 pf.—50.	k 52½	49	53
Radio Corp. of Amer., com.—no par.	60½	41½	65
Republic Ry. & Lt., pf.	m120	....	....
Republic Ry. & Lt., com.	m135	112	135
Rochester Gas & Elec. 6% pf. D.	k104	101	103½
Rochester Gas & Elec., 7% pf. B	106	105	107
Rochester Gas & Elec., 6% pf. C.	104	101½	103½
SAFETY CABLE, com. $4	73	52½	74½
San Joaquin Lt. & Pwr., 7% pr. pf	106	105	108
St. Joseph Ry., L., H. & P., 5% pf.	72	70	73
Servel Corp.	2	1	10½
Sierra Pacific Elec., 2% com.	k 26	26	28½
Sioux City Gas & Elec., 7% pf	102	99	104
Southeastern Pwr. & Lt., pf.—$7 no par	l105	....	....
Southeastern Pwr. & Lt., ptc. pf.	l 79½	....	....
Southeastern Pwr. & Lt., com.—no par	37½	29½	38½
So. Calif. Edison, 8% pf.	38	36½	38
So. Calif. Edison, 7% pf.	k 28	27½	28½
So. Calif. Edison, 6% pf.	k 26	24½	27
So. Calif. Edison, 8% com.	36	31½	36½
Southern Cities Utilities, 7% pf.	73	67	86½
Southern Cities Utilities, com. $4	m 37	....	....
Southwestern Lt. & Pwr., A $3.	63	60	65
Southwestern Lt. & Pwr., B.	63	60	65
Southwestern Lt. & Pwr., $6 pf.	89	83	91½
Southwestern Pwr. & Lt., 7% pf.	k108	103	110½
Springfield (Mo.) Ry. & Lt., 7% pf.	102	95	102
Standard Gas & Elec., 8% pf.	63	57½	64
Standard Gas & Elec., 7% pr. pf.	106½	103	110
Standard G. & E., com. $3.50—no par	62½	54	65½
Standard Pwr. & Lt., 7% pf.	100	98	102½
Staten Island Edison, pf.—$6—no par.	100	99	101
Superheater, $6 com.—no par.	k170	170	185
Syracuse Lighting, 7% pf.	105½	103	107
Syracuse Lighting, 8% pf.	115	118	115
Syracuse Lighting, 8% com.—no par	m300	....	....
TAMPA ELEC., com. $2.	58	....	....
Tenn. Elec. Pwr., 6% pf.	96½	92	97
Tenn. Elec. Pwr., 7% pf.	107	103	106½
Terre Haute, Ind. & East. Trac., 5% pf.	26	20	30
Terre Haute, Ind. & East. Trac., com	1	1	3
Tex. Pwr. & Lt., 7% pf.	l109	106	109
Tide Water Pwr., 8% pf.	108½	105	110
Timken Roller Bear., com.—$4 no par.	141	78	141
Toledo Edison, 8% pf.	115	115	118
Toledo Edison, 7% pf.	l106½	....	....
Toledo Edison, 6% pf.	k 98	95	97
Toledo Edison, 6% com.	98	....	....
Tri-City Ry. & Lt., 6% pf.	96	90	97
UNITED GAS & ELEC., 6% pf.	101	98	102
United Gas & Elec., com.—no par.	m 57	....	....
United Gas & Elec. (N. J.) 5% pf.	70	70	73
United Gas Impr., 8% com.—50.	c 110½	89½	108½
United Lt. & Pwr., pf.—$4—no par.	50	49	53½
United Lt. & Pwr., pf.—$6.50—no par.	95½	87	97½
United L. & P., com. A .48—no par.	13½	12½	15½
United L. & P., com. B .48—no par.	k 18	14	19
Utah Pwr. & Lt., 7% pf.	l 107½	104	108½
Utica Gas & Elec., 7% pf.	105	105	106½
Utica Gas & Elec., 8% com.	200	....	....
Utilities Pwr. & Lt., 7% pf.	95½	93	100
Utilities Pwr. & Lt., com. A $2.	31	27	34
Utilities Pwr. & Lt., com. B $1—no par.	k 18	13½	19
VERMONT HYDRO-ELEC., 7% pf.	98½	95	100
Virginia Elec. & Pwr., 7% pf.	107	105	107
Virginian Pwr., 7% pf.	108	....	....
Virginian Pwr., com.	75	....	....
WAGNER ELEC., 7% pf.	m 88	68	90
Wagner Elec., com.—no par.	b 32	18½	39½
Washington Ry. & Elec., 5% com.	j259	....	....
Washington Ry. & Elec., 5% pf.	j 92½	....	....
Washington Wtr. Pwr., 8% com.	156	136	168
West Penn Elec., 7% pf.	111½	102	112
West Penn Elec., Cl. A $7.	k107	97½	110
West Penn Pwr., 7% pf.	114½	111	118
West Penn Pwr., 6% pf.	107½	100½	108½
West Virginia Lt., Ht. & Pwr., 7% pf.	90	94	96
West Va. Utilities, 7% pf.—50.	m 90	48	51½
Western Pwr., 7% pf.	k 99	98	101½
Western States Gas & Elec., 7% pf.	99½	96	100½
Western States Gas & Elec., com.	37	....	....
Westinghouse Elec. & Mfg., 8% com.—50.	89	67½	89
Weston Elec. Instrument, Cl. A $2—no par.	32	30	34½
Weston Elec. Instrument, com.—no par.	k 14	13½	18½
Wheeling Elec., 6% pf.	100	95	100
Worthington Pump, 7% pf. A.	55	46	61½
Worthington Pump, 6% B.	k 45	40	54½
Worthington Pump, com.	37	20½	46
YALE & TOWNE com. $5—25.	82	70½	82

Stock Exchange: *a*Chicago; *b*St. Louis; *c*Philadelphia; *d*Boston; *e*Baltimore; *f*Montreal; *g*Cincinnati; *h*San Francisco; *i*Pittsburgh; *j*Washington. *k*Bid price Saturday, July 30 *l*Bid price Wednesday Aug. 3. *m*Latest quotations available. †Dividend rate variable.

deal in electricity, with capital of 500,000 shares first preferred and 2,500,000 common stock both of non-par value.

Changes Capital Set-Up.—Electrical Securities Corporation has filed a certificate in the office of the Secretary of State changing the par value of its capital stock from 35,000 shares of $100 par value to 250,000 shares of non-par value.

Interstate to Sell Bonds.—Authority has been granted the Interstate Public Service Company of Indianapolis, operating gas, electric and traction utilities in Indiana, to issue and sell $1,979,200 of 5 per cent, series D, first mortgage and refunding bonds and $15,000 in common stock. The authority was granted by the Indiana Public Service Commission, and the proceeds are to be used for reimbursing the treasury for betterments and additions.

Recent Listings.—The New York Stock Exchange has authorized the listing of 1,328,219 shares of common stock of the American Water Works & Electric Company, Inc. (Delaware), without par value, on official notice of issuance, in lieu of common stock or scrip certificate for common stock of the American Water Works & Electric Company, Inc. (Virginia), and certificates of deposit issued pursuant to the provisions of the plan for reincorporation of the Virginia company, dated June 16, 1917, and on official notice of issuance to the Virginia company in part payment of the consideration due upon the acquisition by the company of the assets of the Virginia company, and 33,206 shares of its common stock on official notice of issuance as a stock dividend, making the total amount applied for 1,361,425 shares of common stock. There have also been authorized for listing additional refunding and first mortgage gold bonds of the Milwaukee Electric Railway & Light Company 5 per cent, series B, amounting to $5,819,000, upon official notice that these bonds have been issued in exchange for $5,819,000 of the general and refunding mortgage gold bonds, series A, 5 per cent, making the total amount of refunding and first mortgage gold bonds, series B, applied for to date $29,119,000.

Associated Gas & Electric Company Stock Price Up.—The Associated Gas & Electric Company has issued notice to holders of common stock purchase rights that the price at which they may purchase common stock in the company will increase from $20 to $30 on Sept. 1. The rights were issued in connection with the 6½ per cent interest-bearing option warrants and the subsequent sale to customers and employees of preferred stock and debentures.

Manufacturing and Markets

Famous Engineering Museum at Munich

Shows Industrial and Technical Development Thoroughly and Interestingly for Engineer and Public

By Edward J. Mehren
Vice-President McGraw-Hill Publishing Company, Inc.

THERE are now being discussed in the United States three projects for technical museums—one for Washington, one for New York under the Henry R. Towne bequest, and one for Chicago which Julius Rosenwald has offered to finance. Such proposals in the United States are not new, the Towne project having originated before the war. But the schemes have lagged. If, however, our engineers, manufacturers, teachers and public officials could see the famous Deutsches Museum of national science and technology at Munich, the projects would go forward with speed. Probably the Chicago project will advance rapidly, for the South Park Commissioners were in Munich recently as Mr. Rosenwald's guests to study and report on the museum.

Try to imagine a single widespread building in which, in models and full-sized operating equipment, one can see and study the machinery, processes, methods and structures of the major branches of engineering and the engineering industries—civil, mechanical, electrical, mining and chemical. That is what the Deutsches Museum contains. Then, as a good engineer should, let one ask that there be added a demonstration of the theory and apparatus of the fundamental sciences—mathematics, physics, chemistry, geology and astronomy. One will not be disappointed. These sciences, too, are well demonstrated and their laws explained. For good measure, there are added thorough exhibits of ship development, of the airplane and the airship, of paper making, printing, textile manufacturing and farming.

Development of Each Art

Such is the general picture. As to the divisions, the plan is to show the development of each art or process historically, from its earliest beginnings to its present state. Conspicuously displayed at the entrance to each division is an explanation of the development, so that the visitor before starting his examination obtains a key to the understanding of what he will see. On each plan, picture, model or item of equipment there is, in turn, an explanation of its purpose, date and place in the development of the art, while for the many large models of steel works, gas plants, chemical industries, etc., there are quite intimate explanations of the successive processes or steps in fabrication. Well-informed guides are available, but one hardly needs them; the great exhibit tells its own story.

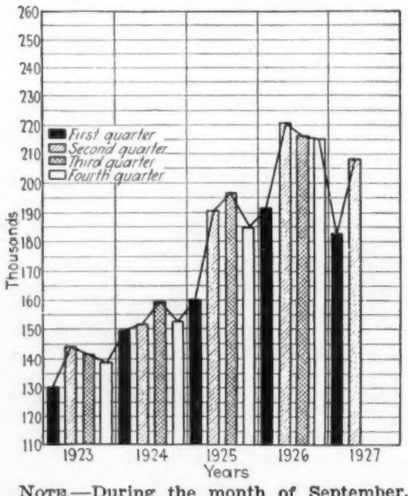
Three points are especially worthy of note. First, the stiffness of a machinery and process exhibit has been relieved by an artistic setting where possible. One comes frequently on large paintings depicting great achievements in engineering and science, canvases sparkling with color, fine examples of the painters art. Secondly, there are thrills at frequent turnings, when one encounters apparatus with which the giants of science or engineering have made their conquests. Who has not heard of the demonstration of air pressure made before a distinguished company by Von Guericke in 1654, when two teams of eight horses each tried to pull apart two halves of the sphere from which the air had been exhausted? Here are the identical hemispheres, while a large painting, dominating the room, sets forth the historic scene. So it is in many other branches covered by the exhibit; here is the original apparatus with which scientific and engineering history has been made. Often where originals are already deposited in museums, exact reproductions have been made for Munich.

Further, and this is the third noteworthy point, the Museum is not only a museum, but a people's laboratory. The visitor himself can perform many of the experiments to demonstrate the fundamental laws of physics and chemistry and of the elemental machines. In addition, most of the full-sized apparatus is operative and is demonstrated on request. An "overseer" is provided for this purpose in each section.

An adequate description of the scope of the museum is impossible in a short space. The guide book alone contains 360 pages of closely printed matter, the exhibits number 40,000 items, the floor space (exclusive of large items displayed in the garden) is 430,000 sq.ft., and the length of the route through the exhibit is just 10 miles. There are many divisions and subdivisions of the exhibit. Two planetaria are among the most interesting features of the whole museum. One shows on a reduced scale the actual paths of the planets against a diagram of the zodiac, and the other shows the planets and their movements as they appear from the earth.

It should be added that the Deutsches Museum, like so many other great undertakings, owes its origin and development to one man, though many have helped. German industry has been lavish in gifts of full-sized operating machinery, models and even building materials for the new structure. But the genius and painstaking direction behind it all have been those of Dr. Oskar von Miller of Munich. He has built a monument to himself and an example for similar efforts throughout the world.

Sales of Electric Washing Machines by Quarters



Note.—During the month of September, 1926, sales of electric washing machines amounted to 76,308 and established a new monthly sales record in the history of the washing-machine industry. Sales during April, 1927, eclipsed that figure and amounted to 78,993. The figure for May was 64,493 and for June, 64,892.

Electric Industrial Trucks and Tractors

June shipments of electric industrial trucks and tractors, as reported to the Department of Commerce by the nine leading manufacturers in the industry, were 140, as compared with 106 in May and 144 in June, 1926. The accompanying table gives the shipments for 1926 and for 1927 up to and including June.

SHIPMENTS OF ELECTRIC INDUSTRIAL TRUCKS AND TRACTORS

	Domestic		
1926	Tractors	All Other Types	Exports
January	21	86	4
February	15	96	5
March	11	128	8
April	17	90	4
May	12	87	9
June	21	104	19
Total (six months)	97	591	49
July	15	95	1
August	14	81	2
September	10	82	5
October	18	97	17
November	18	86	19
December	18	95	5
Total (year)	190	1,127	98
1927			
January	6	67	17
February	11	120	7
March	10	96	10
April	12	89	4
May	19	77	10
June	20	97	23
Total (six months)	78	546	71

ORDERS FOR ELECTRICAL GOODS

Quarter	1922	1923	1924	1925	1926	1927
First	$143,320,453	$225,399,383	$228,760,838	$233,023,182	$262,677,736	$251,627,340
Second	165,370,750	240,542,824	221,167,876	227,502,652	248,000,075	243,826,893
Third	167,984,466	201,910,099	185,747,314	232,933,532	241,114,209	.....
Fourth	192,473,402	218,165,415	231,470,552	244,597,050	260,078,082	.....
Total	$669,149,071	$886,017,721	$867,146,580	$938,056,416	$1,011,870,102	.....

* Revised.

Orders for Electrical Goods

New orders booked during the second quarter of 1927, as reported to the Department of Commerce by 86 manufacturers of electrical goods, were $243,826,893, as compared with $251,627,340 for the first quarter of 1927 and $248,000,075 for the second quarter of 1926. The accompanying totals of bookings for each quarter since the beginning of 1922 are presented, not as a complete statement of the industry, but as probably sufficiently representative to indicate the trend:

Record Year for the British Electrical Manufacturers

A new high record in the history of the British electrical industry is represented by the orders secured by the electrical manufacturers for generating plant and heavy equipment during the year ended June, 1927. On a horsepower basis the total increase over 1920 was 28 per cent. Uncertainty regarding the national situation and severe trade depression caused domestic sales to decline 6 per cent below the 1920 level, but export business showed the remarkable increase of 134 per cent. In the first half of 1927 British firms booked contracts aggregating a higher plant capacity than during the whole of 1924 or 1925.

Australia, Japan, New Zealand, South Africa and South America were the principal markets affected. Important railway electrification developments, large water-power and steam superpower schemes and extensive transmission and distribution systems formed the object of valuable contracts, amounting in several cases to hundreds of thousands of pounds. In Europe the British electrical industry is advancing steadily, while in the Far East, the Straits Settlements, Africa and Canada it has been able to strengthen its position markedly during 1926.

It is estimated that more than 60 per cent of all contracts for generating plant in the world, outside of the main industrial countries, and more than 70 per cent of all traction orders, especially in railway electrification, fell to British manufacturers. During the first five months of 1927 export shipments of $38,785,000 showed an increase of 11.5 per cent over the corresponding period of 1926, a previous record. German exports declined during the same period by 3 per cent, French exports fell 24 per cent, while American exports showed an increase of about 4 per cent and Swiss exports increased by 10 per cent. Consequently Britain's share of export trade relative to the four other leading competing countries has increased to 32 per cent. This compares with 23 per cent recorded in 1913.

Business Conditions

APPARATUS sales are reported in good volume in the electrical industry. Transformer business is active and many inquiries are in the market. Interesting sales of steam turbo-generating units, synchronous condensers and switching equipment were also recorded. Line construction material is in active demand in the Southeast and St. Louis districts, where extensions of lines are under way. Central-station companies show a steady increase in the sale of appliances.

In New England continued improvement in the sale of electrical equipment is noted, transformer buying shows increased activity, and industrial electric heating equipment is selling in good volume. A 35,000-kw. steam turbine generating unit was sold for installation in Texas. Power companies are showing a little more activity in the New York district, there are a larger number of inquiries for quotations in the market, and transformer sales are good. In the Southeast central-station buying has been the best in several weeks. Prominent orders included $120,000 worth of synchronous condensers and transformers, $21,500 worth of switchboard, circuit-breaker and transformer equipment, as well as a number of good wire and cable sales. Sales continue in good volume in the St. Louis district.

On the Pacific Coast $80,000 worth of railway equipment was sold in San Francisco, and a number of requests for prices on power and telephone line material were received from lumber companies in Oroville, Scotia and Madera. Good range business is reported in the Fallon and Minden districts of Nevada. Business is improving steadily in the Middle West.

Delinquent Electrical Accounts

(Data Supplied by National Electrical Credit Association)

NUMBER OF ACCOUNTS REPORTED

Division	June 1926	June 1927	Per Cent Increase or Decrease	Six Months 1926	Six Months 1927	Per Cent Increase or Decrease
New York	422	299	—29.1	2,400	2,114	—11.9
Middle and Southern Atlantic	125	168	+34.4	1,163	981	—15.7
New England	83	158	+90.3	541	925	+70.9
Pacific Coast	21	15	—28.5	167	99	—40.7
Central	877	886	+1.03	5,638	5,743	+1.86
Total	1,528	1,526	—0.13	9,909	9,862	—0.47

TOTAL AMOUNTS REPORTED

Division	June 1926	June 1927	Per Cent Increase or Decrease	June 1926	June 1927	Per Cent Increase or Decrease
New York	$71,745	$35,464	—50.5	$356,730	$324,670	—9
Middle and Southern Atlantic	12,720	20,573	+61.7	124,121	122,789	—1.1
New England	8,751	18,596	+112.5	51,812	97,382	+87.9
Pacific Coast	2,538	1,552	—38.8	29,331	13,554	—53.7
Central	96,837	98,884	+2.11	808,308	670,495	+10.6
Total	$192,591	$175,069	—9.09	$1,168,302	$1,228,890	+5.19

AVERAGE AMOUNTS

Division	June 1926	June 1927	Six Months 1926	Six Months 1927
New York	$170	$118	$889	$917
Middle and Southern Atlantic	101	122	632	748
New England	105	117	588	635
Pacific Coast	121	103	971	1,028
Central	110	112	645	704

Non-Ferrous Metal Prices Continue to Increase

Buying of copper, lead and zinc has been active on the non-ferrous metal market, and prices have advanced all along the line. Copper gained the most ground with a net advance of ⅝ cent per pound in the domestic market and ¼ cent in the c.i.f. price of the export association. Lead has increased in price ¼ cent, tin almost 2 cents and zinc 10 points. The most important factor perhaps is the strength of the European support. Copper in particular has been in heavy demand abroad for several weeks, and apparently this has helped convince domestic consumers that the metal is cheap. The undivided front presented by the producers, who without exception are confident of the im-

NEW YORK METAL MARKET PRICES

	July 27, 1927 Cents per Pound	Aug. 3, 1927 Cents per Pound
Copper electrolytic	13	13⅜
Lead, Am. S. & R. price	6¼	6½
Antimony	12½	12
Nickel, ingot	35	35
Zinc spots	6.675	6.775
Tin, Straits	63⅜	65
Aluminum, 99 per cent	26	26

Base copper price Aug. 3, 1927, 15 cents.

mediate outlook, has also stimulated domestic buying. Europe has been buying lead and zinc, and in addition the buoyancy of the copper market has had a sympathetic influence on the markets for the other metals. There seems to be no decisive change in the domestic industrial outlook to warrant an advance in metal prices, and the explanation frequently offered for the recent advances is that prices have been unwarrantably low.

Sales Continue in Good Volume in St. Louis District

Industrial plant purchasing has been slightly lower in the St. Louis district, but is holding up in good volume for the midsummer season. The city of St. Louis has just bought $10,000 worth of cable to be used in street-lighting construction, and an order has been placed for a municipal light and water plant in Arkansas, to cost $85,000. Another contract was closed with an operating company in the Southwest for a 3,000-kw. turbo-generator unit and accessories to cost $90,000. Line construction material continues to be shipped in good volume to the southwestern section of the district. Electrical contractors are busy figuring wiring jobs on the new court house and several large office buildings, hotels and apartment houses in St. Louis.

Large Railway Equipment Order Placed on Pacific Coast

An outstanding order placed on the Pacific Coast covered ten complete Westinghouse quadruple railway equipments for the municipal car system of San Francisco, at a cost of $80,000. Other interesting orders included three substation circuit breakers for San Francisco, valued at $10,000; two assortments of fans, chiefly of the desk type, sold through jobbers for shipment to the Sacramento and San Joaquin Valleys, at a total value of $8,500; one carload of 9-in. locust pins, one carload of 3-in. fiber conduit, two carloads of 55-ft. poles, one carload of 60-ft. and 65-ft. poles, $3,000 worth of fire alarm cable for Berkeley, valued at $2,500, and $2,000 worth of 12-in. steel pins for a power company. A number of requests for prices on power and telephone line material, averaging $2,500 each, were received from lumber companies in Oroville, Scotia and Madera. The opening of new short power extensions in Nevada has produced good range inquiries in the Fallon and Minden districts. A new ice plant to cost $300,000 is planned for Stockton, and a new street-lighting system for Ontario, Cal. Railroad purchases continue very good and consist mainly of schedule material, rubber-covered wire and conduit.

The Board of Public Works, Seattle, has received a bid of $29,000, the lowest in six, for furnishing four 3,000-kva. transformers and is now taking bids for 16,000 ft. single-conductor, 600-volt lead-covered cable. A considerable amount of miscellaneous apparatus and materials, including transformers for distribution system, wire, pole-line hardware, etc., has been purchased by power companies. In the Seattle district electric range sales are reported behind those of last month, and they are approximately 40 per cent less than they were last year at this time. There are no indications of an improvement. General merchandising is reported in fair shape, although collections are said to be not very good. Motor sales include twenty from 150 hp. down for a lumber mill in southwest Washington, ten from 75 hp. down for a planing mill and fifteen from 10 hp. down for a cold-storage installation. The placing of downtown power and light lines underground by the Grays Harbor Railway & Light Company of Aberdeen is resulting in a number of orders for the necessary equipment.

Business Improving Steadily in Middle West

A slight improvement of business in the Middle West is noticeable. While industrial activity is still somewhat spotty, a greater volume of business is being transacted and it is generally felt that business will continue to improve slowly. The various utility companies continue a conservative policy, although more construction work is being started and commitments are increasing, one utility company's purchases averaging $86,000 per day as against $40,000 per day in June. Interesting orders placed included two motor-driven two-stage air compressors, nine condensers for klydonographs on 132-kv. service, spare boiler and pump parts valued at $16,000 and a quantity of disconnecting switches. Maintenance purchasing also has increased substantially. Jobbers report a slight increase in the volume of business. Most appliances are moving in fair volume, particularly washing machines and vacuum cleaners. Heavy-duty hotel and restaurant equipment sales are quite substantial. Manufacturers of rubber-covered code wire advanced their prices 2½ per cent, effective Aug. 1. Lead sleeving advanced in price 25 cents per 100 lb. July 30, and higher prices for lead-covered wires and cables are anticipated.

Central-Station Buying Active in Southeast

General activities in the electrical field in the Southeast continue to show improvement, with central-station orders the best in several weeks. The largest individual order was for $120,000 worth of synchronous condensers and transformers for a substation job, while another order was for $21,500 worth of switchboard, circuit-breaker and transformer equipment for another substation installation. Wire and cable sales are good, one company ordering last week solid copper wire amounting to $15,300, while some of the other orders called for $3,100 worth of stranded copper wire and stranded aluminum cable totaling $5,400. A power company in the Carolinas placed an order for power-plant switchboard equipment amounting to $25,000, while a power company in Alabama ordered approximately $4,000 worth of indicating instruments for a power-plant switchboard. The movement of transformers is reported reasonably good, one company placing an order for three 1,500-kva. and one 50-kva. transformer, costing approximately $15,000, and $7,350 worth of distribution and small power transformers.

The expansion activities of the larger power companies continue to be reflected in the satisfactory movement of line construction materials, transformers, motors and metering equipment, one company ordering $8,000 worth of creosoted pine poles, $3,625 worth of insulators and 5- 10- and 25-amp. meters totaling $5,200. One company's purchases of small disconnecting switches totaled $4,250. Merchandising activities of central-station companies are brisk. A power company closed an order covering the installation of 48 electric refrigerators in an apartment house, and the order for 48 electric ranges for the same installation is in immediate prospect, with the further anticipation of installing 40 electric logs at a later date.

Power Companies More Active in New York District

Increase in activity in the New York district is indicated by the volume of inquiries for quotations that are being received from central-station companies, but sales continue generally quiet. Poles, cross-arms and hardware sales are very dull, both sales and inquiries being limited to small quantities. Switching equipment is somewhat spotty in demand, with some increase reported in the volume of inquiries. Transformers, both in number of sales and inquiries, are more active and one manufacturer reports an increase in buying during July over recent months. Sales of motors to industrial users show some recession, particularly in the larger-sized equipments, although fair sales of small motors continue to be made to makers of machine tools, pumps, sewing machines, etc.

Apparatus Sales Good in New England District

Continued improvement in the sale of electrical equipment is noted in the New England district. An operating syndicate purchased a 35,000-kw. steam turbine unit for Texas, transformer buying by central-station companies displayed increased activity, and industrial electric heating equipment sold in good volume. Representative orders for the latter equipment covered a 70-kw. heat-treating furnace for Torrington, Conn., and several outfits for use in the Middle West. A loom manufacturer in New England bought about $2,000 worth of motors for individual drive, and motor sales, while greatly diversified and confined mainly to widely scattered small orders, reflect more activity in industry.

A slight improvement is apparent in the textile field, and building operations are still being maintained at a high level, leading to fair sales of wiring supplies and a volume of meter sales well above last year. Both domestic and commercial refrigerating apparatus are moving in increased volume. A distributor who reports 100 per cent more business in each line than a year ago credited this to intensive canvassing and price reductions, as well as to central-station co-operation and more

favorable rates for service. Jobbers report excellent business in fiber conduit, with a slight falling off in sales of line material. Last week a leading syndicate of operators sold $15,229 in electrical appliances, compared with $11,591 a year ago, and for the period from Jan. 1 to July 23 this group was 8 per cent ahead of the same part of 1926. Washing machines, flatirons and vacuum cleaners have been very active sellers according to this syndicate.

Activities of the Trade

Two Illinois Wire Companies Plan Consolidation

Plans have been prepared by the Illinois Wire & Cable Company and the Chicago Insulated Wire Manufacturing Company, both of Sycamore, Ill., for merging the two companies under the name of the Inland Wire & Cable Company. The plans will be presented to the respective stockholders on Aug. 8. The proposed company will have an authorized capitalization of 200,000 shares of $10 par value, of which not more than 105,000 shares will be issued. All the corporate assets of the Chicago Insulated Wire Company would be acquired for $600,000 and 16,000 shares of the new organization's stock, which would be exchanged share for share for the stock of the Chicago company.

Hart & Hegeman and Arrow Electric Approve Consolidation

Directors of the Arrow Electric Company, Hartford, Conn., have approved the general consolidation plan which will unite the company with the Hart & Hegeman Company of that city. The two companies will combine to operate through a holding company with a view to eliminating duplicate products and to introduce economy in manufacture. The products of the two concerns are similar, both manufacturing electric wiring devices. Each company has a branch plant in New Jersey as well as manufacturing facilities in Hartford. No changes in the personnel of either company is planned. A statement signed by Samuel P. Williams, president of the Hart & Hegeman Company, and Edward P. Grier, vice-president of the Arrow Electric Company, is as follows: "The officers and directors of the two companies believe that by consolidating the business of the two companies there will be a great saving in expense and a gain in efficiency which will be for the benefit of stockholders of the holding company, who will be the same persons who are now the holders of the common stock of both companies."

Changes in stock capitalization are planned. The Hart & Hegeman Company will increase its number of common shares. The common stock is valued at $200,000, and present holders of the stock will receive one and one-half shares additional for each share held, to raise the valuation to $500,000. A new preferred stock will be issued to the amount of $1,333,300. The money raised by a sale of $533,300 of the new stock will be used to retire the present preferred. The balance of new stock to the amount of $800,000 will be given to stockholders as a dividend. The holding company will then acquire the common stock of both companies. The Arrow Electric Company is capitalized for $2,750,000.

Diamond Electric Manufacturing to Make Switchboards in West

The Diamond Electric Manufacturing Company of Los Angeles, a new company, has purchased and consolidated the properties of the Safety Electric Products Corporation and the Brown & Pengilly Company. Officials of the Southern California Edison Company and the Electrical Products Corporation, together with the Fleishhacker interests of San Francisco, are organizers of the new company, which will manufacture switchboards, switches and electrical metal products.

The directors of the new company are Paul D. Howse, president; Vernon Brown, vice-president; Joseph Pengilly, John B. Miller, H. B. Woodill, Fred B. Lewis and Luther J. Lee. The company will use the plant of the Safety Electric Products Corporation at East Sixteenth Street, Los Angeles, and also has begun construction of a new two-story office building on the site. The Los Angeles plant has a floor space of 44,000 sq.ft. The company will also have a plant in San Francisco. It is planned to distribute the products as the "Diamond E" line, and it is intended to extend operations into New Mexico, Texas, Colorado, Washington and Oregon. The new company is capitalized at $1,000,000. Last year the two purchased companies did a combined gross business of $1,087,000, and it is expected that the business this year will approximate $2,000,000.

The Railway & Industrial Engineering Company, Greensburg, Pa., states that a continuous operation test of a 37-kv. type TTR "hi-pressure" contact switch recently has been completed before the public at several conventions. This switch made a total of 9,062 operations. At the end of the run the jaw pressure was found to be the same as it was before operating. A full load of 600 amp. was then passed through the switch and the temperature of the contact showed a rise of 23 deg. C., after deducting the ambient temperature (27 deg. C.) from the thermometer reading, which was 50 deg. C.

The Lincoln Electric Company, Cleveland, in a letter to its customers, has announced that it has again decided to virtually close its factory during the period from Aug. 8 to Aug. 22, so that all employees can take vacations at the same time. The company states that in previous years, when vacations have been scattered over a period of three to four months during the summer, it has resulted in more or less overloading of the various departments throughout this period. The company will maintain a skeleton organization during the vacation period.

The Maytag Company, Newton, Iowa, manufacturer of washing machines, announces that the distribution of about $150,000 to its employees on the seventieth birthday of F. L. Maytag, founder of the company and chairman of its board, was a personal gift of Mr. Maytag, instead of a presentation by the company as announced in the July 23 issue of the ELECTRICAL WORLD.

The Eureka Vacuum Cleaner Company, Detroit, reports for the first half year of 1927 a net profit of $761,128 after expenses, extraordinary charges incidental to bringing out a new model, and federal taxes, equivalent to $2.89 a share on 262,500 shares of stock of no par value. This compares with $786,799, or $3.14 a share, earned on 250,000 outstanding in the first half of 1926.

The Baldor Electric Company, 4351 Duncan Avenue, St. Louis, manufacturer of electric motors, announces the appointment of W. F. Murphy, 1747 Ogden Street, Denver, as district representative for Colorado, Wyoming and New Mexico.

The Federal Electric Company, Chicago, manufacturer of electric signs, household appliances, etc., announces the opening of a downtown office in Chicago at 251 Marquette Building, 140 South Dearborn Street.

The General Electric Company will close its Decatur (Ind.) plant for two weeks owing to a slowing down of orders, according to the management. In commenting on the closing order, E. W. Lankenau, superintendent, stated that the seasonal decrease in shipping orders has been such that the normal stock will be able to carry the plant over that period. The company officials are urging all employees to take their vacations during this period in order that the program of the factory may not be hampered after work has been resumed.

The Eureka Vacuum Cleaner Company, Hamilton and Dewey Avenues, Detroit, announces a new Eureka cleaner embodying many improvements.

The McIntosh & Seymour Corporation, Auburn, N. Y., manufacturer of Diesel engines, announces the appointment of Frederick M. Fisk as manager of the Pacific Coast office, 815 Sheldon Building, San Francisco.

The Blaw-Knox Company, Pittsburgh, manufacturer of steel products, announces the opening of an office at 411 Matson Building, San Francisco, with C. D. McArthur in charge.

The Allen-Bradley Company, Milwaukee, manufacturer of control apparatus, announces the removal of its Philadelphia office to 600 South Delaware Avenue. George F. Pain is district manager.

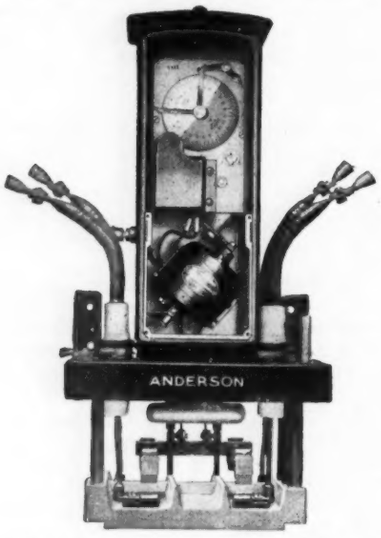
The Corning Glass Works, Corning, N. Y., announces that Thomas S. Wood has been appointed representative with headquarters at 505 Polson Building, Seattle, to handle the sales of "Pyrex" power insulators in the states of Oregon and Washington.

New Equipment Available

Automatic Time Switch

An automatic-motor-driven time switch which incorporates a season changing device has been developed by the Albert & J. M. Anderson Manufacturing Company, 289 A Street, Boston. The time switch is wound by an electric motor and will automatically close and open a circuit at a predetermined time. By the use of additional hands or pointers the time switch can be arranged to open and close a circuit a number of times.

An attachment called a season changing device can also be incorporated and



A SEASON CHANGING DEVICE INCORPORATED WITH THIS AUTOMATIC TIME SWITCH PERMITS IT TO OPERATE WITH THE SUN

may be very easily inserted in the switches. By the combination of gears and a worm this device will follow the rising and setting of the sun throughout the year in relation to the operation of the time switch. By a simple adjustment the season changing device will operate in any latitude between Hudson Bay and Cape Horn. The device is so constructed that there is a maximum error of only fifteen minutes at sunrise on Aug. 15 and a similar error for sunset on May 15, but on Dec. 15 and June 15 the time switch will be right with the sun.

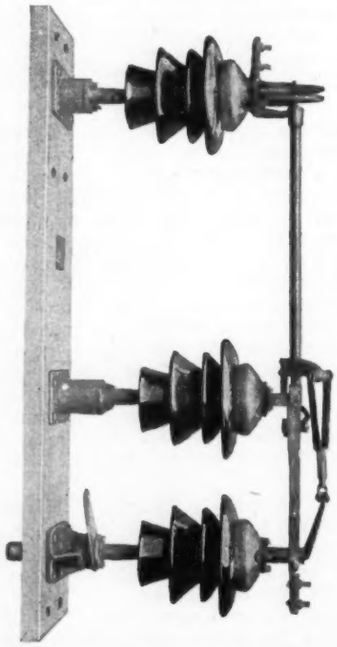
Powdered-Coal Burner

A new type of powdered-coal burner, known as the Toronto, in which the coal is introduced through a large rectangular inlet into a screw-thread-vaned burner barrel, has been developed by the Peabody Engineering Corporation, 110 East Forty-second Street, New York. The interior arrangement used is said to give the coal an even distribution into the blast of combined primary and secondary air whirling through the barrel or body of the burner. When viewed through a peephole, the flame from this burner is said to show no stratification or dark streaks, which would indicate a spotty distribution of the powdered coal.

In a test of the burner feed at the original installation, at the Ohio River Edison Company's plant at Toronto, Ohio, coal was burned at the rate of 5,000 lb. per burner per hour, with six burners operating on one boiler, and at the rate of 6,000 lb. per burner per hour when the number of burners was reduced to four. The CO_2 reading measured 16 per cent, which means that the air supply was so exactly gaged that all the coal was completely burned and no heat units lost in incomplete combustion. This performance measured combustion at the rate of 30,000 B.t.u. per cubic foot of furnace volume per hour. The steam output reached a peak load of 325,000 lb. per hour, which is 445 per cent of the manufacturer's capacity rating for the 2,200-hp. boilers installed at this station. There was no slag produced. This burner can be used with any unit pulverizer or any type of feeder from a bin system of powdered-coal storage.

High-Pressure Contact Switch

The type TTR "hi-pressure" contact switch, built by the Railway & Industrial Engineering Company, Greensburg, Pa., and given an extensive field test, is designed for both load-breaking and disconnecting purposes. The switch shown is a vertically mounted disconnecting switch which can be used as an air-break switch by adding horns and mounting in a horizontal position. High-pressure contact is obtained by the blade rotating after it enters the chrome steel reinforced jaw, cleaning all contact surfaces of film and corrosion, and cutting down contact resistance. The rotating insulator column is supported on double Timken bearings, alemite-lubricated. The voltage range is from 7,500 to 200,000.

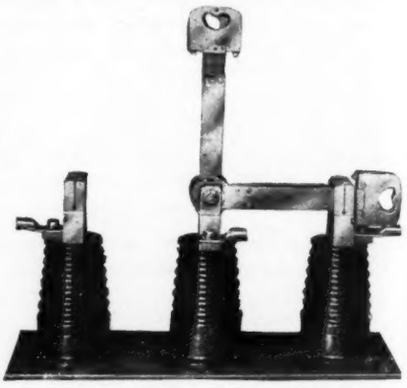


TYPE TTR "HI-PRESSURE" CONTACT SWITCH USED AS VERTICAL DISCONNECTING SWITCH

Triple-Lock Transfer Switch

A triple-lock, double-throw transfer switch having a capacity of 300 amp. at 13,800 volts has been developed by Thoner & Martens, 463 Commercial Street, Boston. This switch has a very positive locking feature for the closed positions and has been developed to meet a limited space condition in certain substations where 13,800-volt construction is used and the line disconnects are most conveniently placed above the transfer bus. This switch will be able to utilize existing transfer buses without increasing the cell center spacings.

The illustration shows a double-



SINGLE-POLE, DOUBLE-THROW, TRIPLE-LOCK TRANSFER SWITCH

blade, single-pole, double-throw switch of 300-amp. capacity. It has a positive locking feature in the closed positions and cannot be thrown through the downward operation without a disengaging operation to unlock it from the clear position. The latching at the 90 deg. or clear position is entirely separate from that in the closed positions, but does not require removal of the switch stick as the relative inclination of its handle operates the proper latch release. These switches are mounted on single-post insulators and 8-in. steel bases, allowing a very economical cell wiring assembly.

Light Tier Tructor

A light-duty 2-ton electric tiering tructor has been added to the mill type series of the Elwell-Parker Electric Company, Cleveland. This machine is designed to handle skid loads as in regular power-lift truck service or to elevate the load from the floor 4 ft. to 8 ft. The truck is of all-steel construction and built on the interchangeable parts basis. The power plant is of the unit type. The manufacturer states that this new truck is a high-speed tool which is built for various height lifts and with several size platforms to suit the materials handled. It is especially designed for the lighter manufacturing branches of industry as well as for warehouses, railroad stores, shops and steamship terminal work.

New Trade Literature

WATER-CONTROLLING APPARATUS.—The Rodney Hunt Machine Company, Orange, Mass., has issued catalog No. 32, covering its water-controlling apparatus, including stands, hoists and gates, for power plants, water reservoirs, irrigation projects, filtration and sewage plants. This catalog is the first section of the general water-power catalog. In this catalog has been compiled the necessary information for both the engineer and the layman for selecting water-controlling apparatus as well as for installing and operating same. Numerous illustrations, line drawings and tables are included.

GENERATOR VOLTAGE REGULATORS.—Bulletin GEA-709 issued by the General Electric Company, Schenectady N. Y., describes its generator voltage regulators. The bulletin contains performance charts showing the improvement in voltage regulation by the installation of a type TA generator voltage regulator. Connection diagrams for various types of voltage regulators are included.

TURBINE-DRIVEN PUMPS.—A leaflet issued by the De Laval Steam Turbine Company, Trenton, N. J., is being distributed entitled "Pumping Chicago's Water." Attention is called to the use of De Laval units on the system.

ELECTRIC FURNACE.—A leaflet by C. I. Hayes, 129 Baker Street, Providence, R. I., describes and illustrates the Hayes "globar" electric furnaces for forging and heat treating, hardening high-speed steel, testing fire clays and refractories, melting non-ferrous metals, etc.

AUTOMATIC COMBUSTION CONTROL.—Bulletin No. 660 issued by the Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, describes and illustrates an automatic system of metered combustion control for boiler furnaces. Apparatus and diagrammatic layouts are shown for both stoker and powdered-fuel plants, also steam flow and pressure charts and CO_2 records illustrating the results attained in commercial plants under automatic control.

EMERGENCY ELECTRIC LIGHT PLANT.—Roth Brothers & Company, 1400 West Adams Street, Chicago, are distributing bulletin No. 901, describing their emergency electric light plant, model No. 7287, for hospitals, theaters and other institutions.

INDUCTION MOTORS.—The Century Electric Company, 1806 Pine Street, St. Louis, is distributing a folder, form 652, describing the assembly of the Century repulsion start induction single-phase motors.

GROUND RESISTANCE TESTER.—Bulletin No. 1160 issued by James G. Biddle, 1211 Arch Street, Philadelphia, covers the "megger" ground resistance tester, a new development for testing the resistance to earth of all types of ground connections for power, lighting, lightning arrester, telephone and telegraph service. A diagram of connections of the "megger" ground resistance tester is included.

MOTOR DRIVES FOR ROLLING MILLS.—The General Electric Company, Schenectady, N. Y., has issued bulletin GEA-151A, entiitled "Motor Drives for Rolling Mills," in which it gives a partial list with many illustrations of main roll motors supplied by the company to Jan. 1, 1927.

INDUCTION MOTORS.—A folder, form 653, issued by the Century Electric Company, 1806 Pine Street, St. Louis, covers the Century high-torque, type DSCH, and normal torque, type DSCN, double squirrel-cage induction, three and two-phase motors. The company is also distributing folder, form 532, describing the Century split-phase induction motors, type SP.

BALL BEARINGS—The Standard Steel and Bearings, Inc., Plainville, Conn., is distributing a booklet containing data sheets covering dimensions, load ratings and price lists of its "SRB" ball bearings. These sheets include all data that the designer might require for the proper application of ball bearings to all types of industrial equipment.

AUTOMATIC LOAD FACTOR REGULATOR.—A folder issued by the Automatic Electric Heater Company, 1505 Race Street, Philadelphia, covers the Clark load factor regulator. It contains a wiring diagram showing the connection of the Clark load factor regulator and an explanation of the operation of the regulator. Included with the bulletin is a copy of the Underwriters' Laboratories report on the regulator.

OIL HEATING.—"Oil Heating the Modern Miracle of Comfort" is the title of a publication issued by the Oil Heating Institute, 350 Madison Avenue, New York City, which is designed to give information about oil heating and oil heating equipment. It contains descriptions and illustrations of the oil heating equipment made by the various manufacturers who are members of the Oil Heating Institute.

ELEVATORS.—Book No. 680 issued by the Link-Belt Company, 910 South Michigan Avenue, Chicago, covers the Link-Belt typical elevators. Illustrations show various installations.

DRUM CONTROLLERS.—Bulletin GEA-743, issued by the General Electric Company, Schenectady, N. Y., covers the General Electric CR-3202 drum controllers for two or three-phase slip-ring induction motors.

INSULATING MATERIALS.—The Mitchell-Rand Manufacturing Company, 18 Vesey Street, New York City, has issued bulletin No. 696, entitled "Compounds," a supplementary catalog, which covers a partial list of its insulating products and other compounds that have been developed and added to its line since the publication of its "General Compound Catalog" No. 550.

RADIO TOWERS.—Bulletin No. 22, issued by Milliken Brothers Manufacturing Company, Inc., 26 Park Place, New York, covers the Milliken radio towers. A number of illustrations showing typical installations of Milliken radio towers and tables of dimensions are included. Attention is also called to the Milliken transmission towers and steel buildings.

WATER INTAKE SCREENS.—Bulletin B-3 issued by the Link-Belt Company, 910 South Michigan Avenue, Chicago, describes and illustrates the Link-Belt "Clean Water" intake screens for screening of condensing water. It contains illustrations showing details of the intake screens and also several typical installations.

APPLIANCES.—Manning, Bowman & Company, Meriden, Conn., are distributing price list No. 234, covering the Manning-Bowman electric household devices as listed in catalog No. 82.

RECORDING AMMETERS.—The Bristol Company, Waterbury, Conn., is distributing catalog No. 1502 covering the Bristol recording ammeters. Illustrations showing the various types of ammeters and reproductions of the different types of charts employed are included. Attention is called to the recording shunt ammeters and to the clock used with Bristol recorders.

BELT CONVEYORS.—The Link-Belt Company, 910 South Michigan Avenue, Chicago, has issued data book 615, entitled "Link-Belt Belt Conveyors," containing information of practical use to engineers, plant operators and all who use belt-conveyor equipment. This book also contains new formulas and new data on belt conveyors. Many illustrations showing typical conveyor installations, as well as idlers, return rolls and other parts, are included.

TOOLS FOR LIVE LINE MAINTENANCE.—Catalog No. 3 issued by the Tip's Tool Company, Inc., 325 East Main Cross Street, Taylorville, Ill., successor to the Improved Hotline Equipment Company, covers the Tip's tools for live line maintenance and reconstruction of high-tension transmission lines.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

Middle Atlantic States

BUFFALO, N. Y.—Plans have been filed by the American Brass Company, 446 Military Road, for the construction of a substation for service at its plant.

ELLICOTTVILLE, N. Y.—Permission has been granted the Niagara, Lockport & Ontario Company, Buffalo, to extend its local electric plant.

NEW YORK, N. Y.—Plans are under consideration by the Board of Transportation for construction of the proposed car shops and maintenance plant of the city's new subway system, to be located on the Harlem River, between 207th and 215th Streets and Tenth Avenue. The plans call for a group of buildings divided into ten units, consisting of machine shops, electrical repair shops, carshops, etc., to cost about $3,000,000.

ROCHESTER, N. Y.—The Eastman Kodak Company is planning to build a new power house at Kodak Park, to cost about $54,800.

SYRACUSE, N. Y.—Bids will be received by Thomas F. Farrell, Commissioner of Canals and Waterways, 353 Broadway, Albany, until Aug. 15, for one 500-hp. Diesel engine directly connected to a centrifugal dredging pump, and a 150-hp. Diesel engine directly connected to a 100-kw. generator, with auxiliary equipment, for local barge canal service. Also, until Aug. 11, for two motor-driven hoists.

WEST HAVERSTRAW, N. Y.—Bids will be received by the Superintendent of Purchase, Division of Standards and Purchase, Executive Department, Capitol, Albany, until Aug. 25 for electric elevator (Specification No. 4892) for Girls' Solaria, New York State Orthopedic Hospital for Children at West Haverstraw.

WINGDALE, N. Y.—Separate bids will be received by the Commissioner of the Department of Mental Hygiene, Capitol, Albany, until Aug. 24 for refrigerating work, kitchen and dining room, building G (Specification No. 4609), and for electric elevators (Specification No. 4728), for the Harlem Valley State Hospital at Wingdale.

CUMBERLAND, MD.—Permission has been granted the Potomac Edison Company, to erect a transmission line from Buckeystown to a number of communities in Montgomery County.

WILLIAMSPORT, MD.—The Potomac Edison Company plans to build an addition to its local substation. A transmission line will be built from Millville and Capon, W. Va., to Williamsport.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, until Aug. 16, for switches, sockets, attachment plugs, etc., (Schedule 7558). Also for ammeters, buzzers, switches, etc., for eastern and western yards (Schedule 7559).

North Central States

PORT HURON, MICH.—The Mueller Brass Company plans to double the capacity of its power plant.

KINGSTON, MICH.—The Michigan Electric Power Company, Bad Axe, which is negotiating for the municipal electric plant, is planning transmission line extensions in this vicinity.

CLEVELAND, OHIO—Separate bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until Aug. 12 for "white way" lanterns and ornamental "white way" lamp standards for the Division of Light and Power.

NELSONVILLE, OHIO—The City Council has authorized the installation of an electric generator, engine, switchboard, etc., in connection with extensions in the municipal waterworks. B. Coakley is engineer.

HAZARD, KY.—The Kentucky & West Virginia Power Company, plans to rebuild its transmission line from First Creek to Coolidge, for increased voltage. Substations in this vicinity will be extended and improved.

CHICAGO, ILL.—A report submitted by the Commissioner of Gas and Electricity to the finance committee of the City Council calls for an appropriation of $1,631,000 for new street lamps. The report recommends the installation of 4,300 lamps in the residential districts, to cost $800,000; 2,500 units on car lines and heavy traffic streets, $365,000, and the balance for 500 lamps in subways under track elevations.

GREAT LAKES, ILL.—Bids will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C. (closing date not given) for mechanical and electrical equipment for power house at local naval training station, including chain grate stokers, motor-driven centrifugal pump, motor-driven skip hoist, etc. (Specification 5405).

DULUTH, MINN.—The City Council is considering a new street lighting plan proposed by the Minnesota Power & Light Company to replace the present system. John Wilson is city engineer.

SIOUX CITY, IOWA—The City Council is considering a report submitted by Arthur L. Mullergren, Board of Trade Building, Kansas City, Mo., consulting engineer, for a municipal electric plant, and also for extensions in the ornamental lighting system. The cost of project is estimated at $300,000.

CALIFORNIA, MO.—The City Council is considering construction of a municipal power plant and waterworks pumping station

ST. LOUIS, MO.—Plans for the proposed cement plant of the Missouri Portland Cement Company, Bell Telephone Building, to be built in the Prospect Hill section, at a cost of about $1,500,000, include a substation.

ST. LOUIS, MO.—Plans have been filed by the Terminal Railroad Association for an addition to its power house at 3251 Scott Street.

BISMARCK, N. D.—Application has been made by the Hughes Electric Company for authority to purchase the electric plants at Mott and New Leipzig.

HAZELTON, N. D.—The Northern Power & Light Company, Mobridge, S. D., has applied for permission to purchase the local electric plant.

VOLGA, S. D.—The City Council is considering extending the electric lines of the municipal plant to Midway Park, 2½ miles east of the city.

ARNOLD, NEB.—Permission has been granted J. E. Paine, owner of the local electric plant, to erect a 2,300-volt transmission line into the rural districts to supply electrical service to farmers.

LODGEPOLE, NEB.—Bonds to the amount of $14,500 have been voted extensions and improvements to the municipal electric light plant. When improvements are completed a twenty-four-hour service will be established.

LOUISVILLE, NEB.—Plans for the proposed local cement mill to be built by the Ash Grove Portland Cement Company, Grand Avenue Temple Building, Kansas City, to cost about $500,000, include a power plant.

WALTHILL, NEB.—Authority has been granted the Central States Electric Company Cedar Rapids, Iowa, to erect a 6,600-volt transmission line from Walthill to Rosalie to supply electric service there.

Southern States

HENDERSON, N. C. — The Carolina Power & Light Company, Raleigh, is planning to build a substation on the Henderson-Oxford Highway, to cost about $50,000.

BUCHANAN, GA.—The Georgia Power Company, Atlanta, plans to erect a 33,000-volt transmission line from Bremen to Buchanan, 8 miles long, and to build a distribution system and street lighting system in Buchanan.

PINECASTLE, FLA.—A franchise has been granted the Pinecastle Water & Light Company, to build a steam-operated electric power plant for local service. The cost is estimated at $100,000.

RIPLEY, TENN.—Permission has been granted the West Tennessee Light & Power Company to extend its electric service to Munford and Atoka, and also to Brighton.

WATERTOWN, TENN.—Bonds to the amount of $10,000, have been approved for the installation of an electric lighting system.

BLUEJACKET, OKLA.—The proposal to grant a franchise to the Empire District Electric Company of Kansas, Joplin, Mo., to supply electric service in Bluejacket will be submitted to the voters on Aug. 8.

MACOMB, OKLA.—A franchise has been granted the Oklahoma Gas & Electric Company to furnish electrical service in Macomb.

DALLAS, TEX.—The Dallas Power & Light Company has been granted a franchise to furnish electric service in University Park.

WHARTON, TEX.—Work has been started by the Houston, Tex. Lighting & Power Company, on the erection of a transmission line to Hungerford to supply power to cotton gins and other plants along the route.

Pacific and Mountain States

PULLMAN, WASH.—Plans are contemplated for the installation of an ornamental lighting system in the business district. The cost is estimated at $17,430.

REDMOND, ORE.—The Deschutes Power & Light Company, Prineville, plans to erect a transmission line from its power plant in the Crooked River Canyon to Redmond and vicinity, about 20 miles long.

GLENDALE, CAL.—The City Council has authorized the installation of ornamental lamps on Idlewood Road, using cast iron standards, and on Wing Street, using concrete standards. A petition is being considered for installing ornamental lamps on the Brand Boulevard, from Garfield Avenue to the Los Angeles city limits, using concrete standards.

LOS ANGELES, CAL.—The Southern California Edison Company plans to build equipment storage and distributing plants at Redlands and Ventura, with repair and reconditioning department.

LOS ANGELES, CAL.—The City Council has authorized the installation of ornamental lamps on Masselin Avenue, and on Ivan Hill Terrace, using concrete standards, and on Fourth Street, using pressed steel standards.

LOS ANGELES, CAL.—Plans for the proposed local mill of the Firestone Tire & Rubber Company, Akron, Ohio, to be erected at Alameda Boulevard and Manchester Avenue, at a cost of about $1,500,000, include a power plant.

SACRAMENTO, CAL.—The City Council has authorized the installation of an ornamental lighting system, maintained by underground wires, on portions of Jeffery and Pacific Avenues, and Sutterville Road. A. J. Wagner is city engineer.

SAN FRANCISCO, CAL.—The lighting committee of the Board of Supervisors has approved the installation of a new lighting system along Judah Street to the beach.

FALLON, NEV.—Plans have been approved by the Truckee-Carson Irrigation District, Carson City. for building two substations, to be connected with transmission system in the Soda Lake district.

Canada

CALGARY, ALTA.—The Canada Power Company is extending its distributing system southward in Alberta to many farming districts, including High River, Okotoka, Nanton, Stavely, Claresholm, Granum, Vulcan, Carmangay, Barons and Nobleford.

VANCOUVER, B. C.—Tenders will soon be called by the British Columbia Electric Railway Company, Ltd., for boring the tunnel in connection with the power development project at Bridge River. The contract will include the tunnel, surge chamber and intake. The tunnel will be about 13,200 ft. long, and 13 ft. in diameter.

SASKATOON, SASK.—The City Council has engaged McClellan & Junkersfeld, 68 Trinity Place, New York, to make a preliminary report for extensions to the municipal electric power plant, including study of possible amalgamation of water works and power plant.

Electrical Patents

Announced by U. S. Patent Office

(Issued July 12, 1927)

1,635,677. ARMATURE-WINDING MACHINE; R. G. Jones, London, England, and C. Zwiebel, Dayton, Ohio. App. filed Jan. 23, 1925.

1,635,726. SAFETY DEVICE FOR HIGH-TENSION WIRES; A. A. Ohlsen, San Francisco, Cal. App. filed Jan. 14, 1924. For emergency use in handling high-tension wires.

1,635,760. CONNECTER FOR ELECTRICAL CONDUCTORS; C. H. Lundy, Wickham, W. Va. App. filed May 22, 1924.

1,635,764. ARC WELDING; E. B. Paxton, Schenectady, N. Y. App. filed Feb. 5, 1927. With single-phase alternating current.

1,635,779. REMOTE-CONTROL CARRIER-CURRENT SYSTEM; E. F. Carter, Schenectady, N. Y. App. filed Aug. 18, 1925.

1,635,788. POWER SYSTEM; J. I. Hull, Schenectady, N. Y. App. filed Aug. 30, 1924. Electric ship propulsion wherein current is supplied to a propeller motor from induction generators driven by Diesel engines.

1,635,794. TRANSFORMER; W. Kummerer, Berlin, Germany. App. filed Aug. 18, 1925. Which must withstand a high direct current potential between primary and secondary windings.

1,635,830, 1,635,831, 1,635,832. ELECTRICAL CONNECTER; W. J. Gagon, Bridgeport, Conn. Apps. filed Feb. 29, 1924, and Sept. 18 and Oct. 1, 1925.

1,635,872. ELECTRIC MOTOR; V. Wisniewski, Berlin, Germany. App. filed June 3, 1924. For imparting reciprocatory, or rotary, motion to a board or carrier bearing advertising matter.

1,635,888. CLUSTER CONSTRUCTION; C. Hanson, Chicago, Ill. App. filed July 6, 1925.

1,635,889. COMBINED LAMP SOCKET AND CURRENT TAP; W. Ile, Jackson, Mich. App. filed May 19, 1925.

1,635,903. ELECTRIC FITTING; M. Peterson and M. J. Danielson, Bridgeport, Conn. App. filed Sept. 17, 1924. Outlet fittings.

1,635,935. SOLENOID MOTOR; A. F. Godefroy, St. Louis, Mo. App. filed April 8,

(Issued July 19, 1927)

1,635,985. NOISE MAKING ALARM; F. Davis, Brooklyn, N. Y. App. filed July 30, 1925.

1,636,029. ELECTRICAL HEATING DEVICE; E. L. Wiegand, Dormont Borough, Pa. App. filed Feb. 1, 1923. Conduction type.

1,636,037. OVERLOAD CIRCUIT BREAKER; C. R. Beall, Swissvale, Pa., and R. M. Gilson, Pittsburgh, Pa. App. filed Nov. 12, 1919. Designed for operation by a prolonged current above a given value but not by a momentary surge of current above such value.

1,636,041. ELECTRIC FURNACE; H. O. Breaker, Winthrop, Mass. App. filed Feb. 9, 1923. Large type designed for the treatment of relatively large quantities of material at one time.

1,636,104. ARC-WELDING MACHINE; T. E. Murray and H. R. Woodrow, New York, N. Y. App. filed Oct. 25, 1919.

1,636,182. FUSE PLUG, SCREW TYPE, WITH INDICATOR; J. B. Glowacki, Chicago, Ill. App. filed May 15, 1922.

1,636,191. PRESSURE-ACTUATED ELECTRIC CONTROL DEVICE; I. E. McCabe, Chicago, Ill. App. filed Nov. 9, 1925.

1,636,193. REEL FOR ELECTRIC CONDUCTORS; A. E. Moone, Chicago, Ill. App. filed Dec. 14, 1923. For extension light, etc.

1,636,266. ELECTRIC WELDING APPLIANCE; J. W. Wilkinson, Kansas City, Kan. App. filed May 4, 1925. Reactance coil.

1,636,277. PANELBOARD; R. B. Benjamin, Chicago, Ill. App. filed June 14, 1920. Residence type.

1,636,278. ELECTRICAL FIXTURE SUPPORTING DEVICE; R. B. Benjamin, Chicago, Ill. App. filed May 20, 1921.

1,636,359. FLATIRON; E. Gates, Washington, D. C. App. filed Dec. 15, 1921. Which may be set to maintain its temperature within certain maximum and minimum limits.

1,636,369. ELECTRIC HEATER; A. Johnson, Oakland, Cal. App. filed July 29, 1925. Adapted for mounting an air supply conduit for supplying heated air to buildings.

1,636,372. HEATING UNIT; M. M. Kohn, New York, N. Y. App. filed Feb. 23, 1921. For use in toasters and devices used for cooking and heating purposes.

1,636,460. PLURAL FILAMENT ELECTRIC BULB; E. R. Cloward, Payson, Utah. App. filed June 22, 1925.

1,636,473. DRY BATTERY CONSTRUCTION; E. E. Meisekothen, Madison, Wis. App. filed April 8, 1925.

1,636,491. ELECTRIC INSULATION BOARD; D. M. Sutherland, Jr., Trenton, N. J. App. filed Nov. 11, 1924. Comprising cellulose, oil soap, acaroid resin, and gilsonite.

1,636,501. PUSH-BUTTON ELECTRIC SWITCH; F. Decraene, Pantin, France. App. filed April 6, 1925.

1,636,527. METHOD AND APPARATUS FOR DETERMINING THE SYNCHRONISM OF ALTERNATING-CURRENT CIRCUITS; G. H. Middlemiss, Birmingham, Ala. App. filed Nov. 3, 1922. Using multi-electric vacuum tubes or valves.

1,636,533. MAGNETIC CHUCK; J. E. Sears, Jr., and A. J. Brookes, Teddington, Middlesex, England. App. filed Nov. 22, 1919.

1,636,544. LIGHTNING ARRESTER CONNECTION; A. L. Atherton, Pittsburgh, Pa. App. filed April 21, 1923.

1,636,580. FUSE-PLUG HOLDER; W. W. Weida, Massillon, Ohio. App. filed Oct. 12, 1925. For 2,200-volt circuits.

1,636,587. ELECTRIC CORD REEL; E. Buddendorf, Philadelphia, Pa. App. filed July 10, 1925.

1,636,606. ARMORED CABLE; A. O. Hoeftmann, Worcester, Mass. App. filed Jan. 31, 1924. For underground, aerial, and submarine use.

1,636,609. ELECTROMAGNETIC RELAY; A. A. Klann, Waynesboro, Va. App. filed July 24, 1925. For use in pipe organs.

1,636,656. WELDING COPPER AND ALUMINUM; J. V. Capicotto, Brooklyn, N. Y. App. filed June 10, 1924. Which consists in coating the copper with solder, bringing the aluminum in contact with the coated copper and then spot welding.

1,636,676. ELECTRIC WELDING APPARATUS; R. Mack, Berlin-Tempelhof, Germany. App. filed Feb. 17, 1921. For automatic cessation of the welding operation.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

The March of Industry

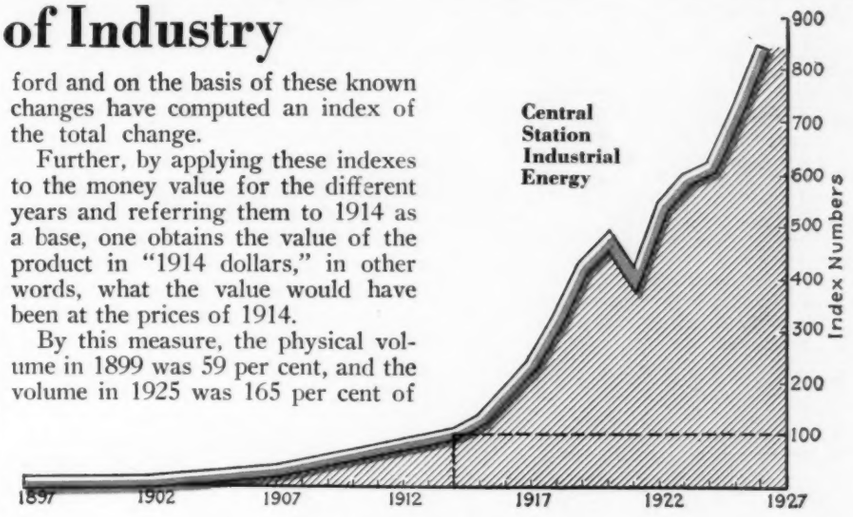
THE recent publication by the United States Bureau of the Census of the major results of the Census of Manufactures in 1925 has suggested to the National Industrial Conference Board a review of manufacturing growth in the first quarter of the present century.

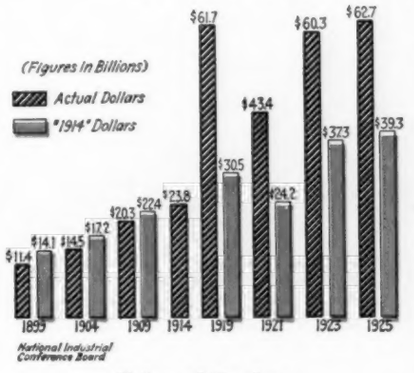
That study has in turn suggested another, namely, the change in amount of central-station energy used for industrial purposes. Though this is not identical with the sales to manufacturing establishments, because there are tens of thousands of small power customers who cannot be classified under the latter head, the growth of the two is nevertheless parallel, and the one serves fairly as a measure of the other.

To determine manufacturing growth by adding up all the tons, gallons, yards, etc., of the various individual products and get a single statement of the volume of manufactured goods would be impossible and meaningless. Yet, if the total volume of manufactured products cannot be measured, it is not impossible to arrive indirectly at a very fair measure of the changes in that volume. For this purpose index numbers are useful. The change in each of the many products can be directly measured in terms of proportion or percentage, and from the combination of all these proportional changes an average change for the total can be computed. The experts of the Bureau of the Census have assembled all the data upon quantity which the records afford and on the basis of these known changes have computed an index of the total change.

Further, by applying these indexes to the money value for the different years and referring them to 1914 as a base, one obtains the value of the product in "1914 dollars," in other words, what the value would have been at the prices of 1914.

By this measure, the physical volume in 1899 was 59 per cent, and the volume in 1925 was 165 per cent of the production in the year 1914.





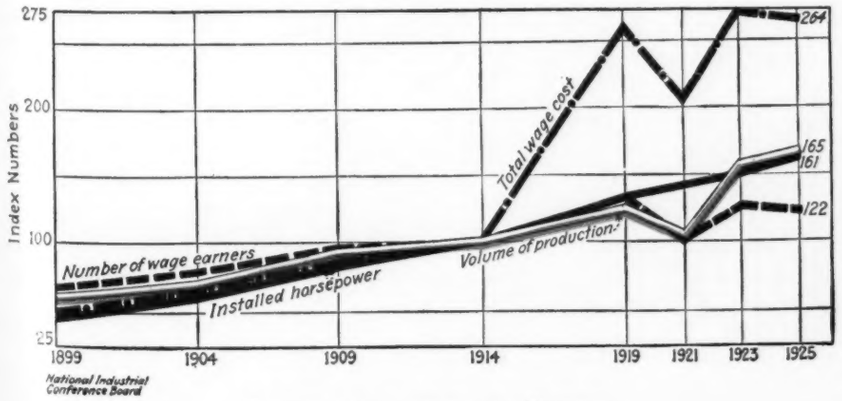
Value of Product

From the census figures indexes for the several other factors entering into the products were also determined and are here charted.

To show the relatively enormous increase in central-station power sales, use can be made of ELECTRICAL WORLD estimates for the various years, also expressed as index numbers. Again taking 1914 as a base (100), the index for 1897, the nearest comparable year to the first one on the chart for manufactures, was less than 1. By 1926 it had risen to 846. In 1925 it was 730. The eleven-year period which saw an increase of 65 per cent in volume of production, 61 per cent in installed horsepower, 22 per cent in number of wage earners, and 164 per cent in total wage cost, also witnessed an increase of 630 per cent in the sale of central-station industrial energy.

The upward turn in the curve during the World War was, no doubt, more than a coincidence, but the movement was already under way. When the call came for a rapid increase in power supply for accelerated production electricity was ready to meet it.

Is there a logical relation between the notable increase in the average wage per worker, with all that it implies, and the extraordinary growth in the use of cheap electrical energy for industrial purposes? It seems reasonable.



Volume of Product and Its Factors

Most of the data for statistics in the ELECTRICAL WORLD are gathered by it from original sources. Privilege is freely given to readers of the ELECTRICAL WORLD to quote or use these statistics for any legitimate purpose. While there is no requirement that the source of data be given, yet it would help the ELECTRICAL WORLD in obtaining and compiling further basic information if those who make use of the statistics would give credit to the ELECTRICAL WORLD.

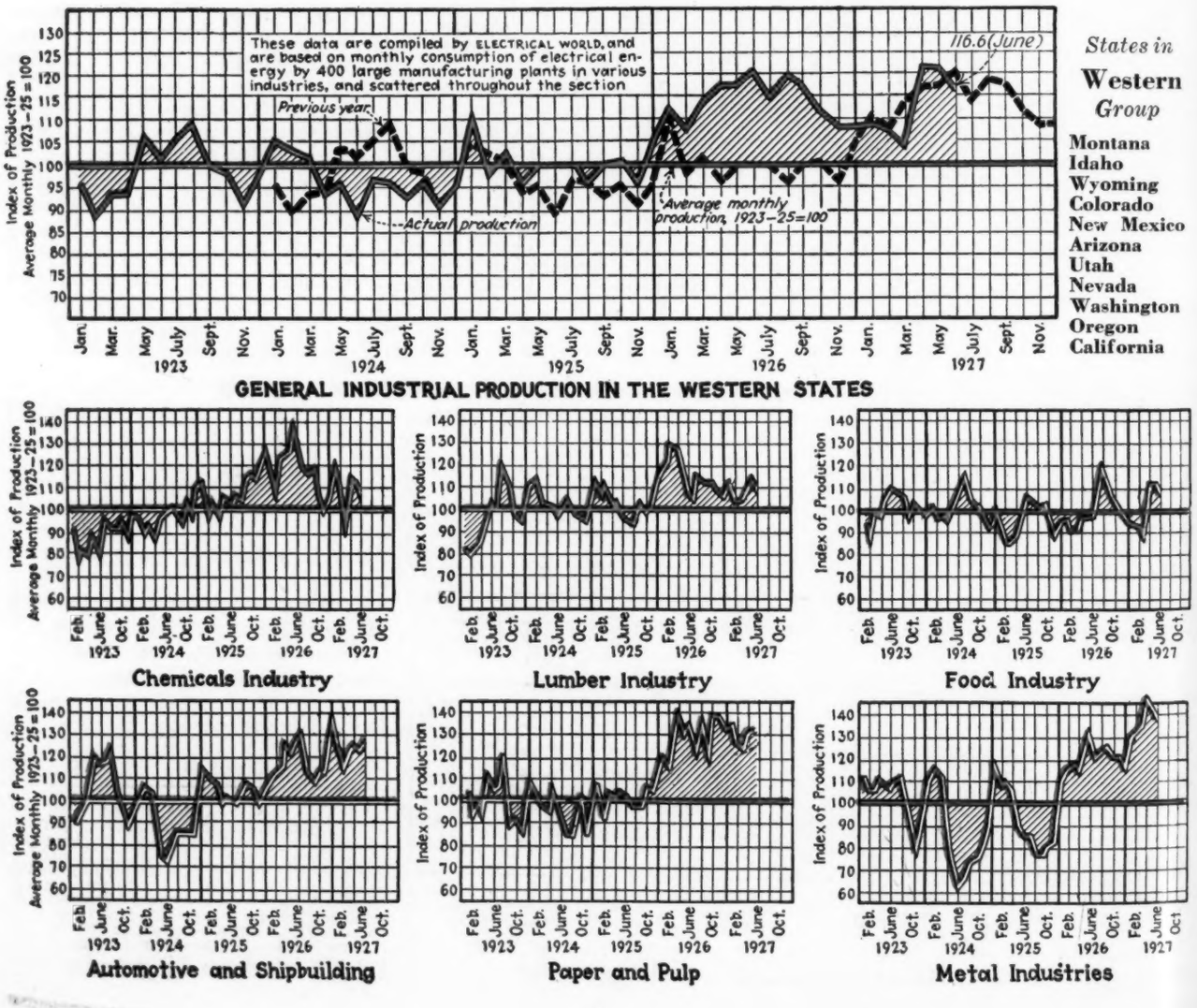
Western Production Continues at High Rate

MANY of the outstanding primary industries of the Western States continued to operate at a high rate of activity during June as compared with June of last year, although a general downward tendency, seasonable in nature, was noticeable in practically all of the industries of the section. June activity in Western industry as a whole was 5.6 per cent under that of May, after corrections are made for the number of working days in the two months. The actual production of general industry during June was 3.6 per cent under that reported for May and 3.7 per cent under June of last year.

The downward trend in the general production of the manufacturing plants of the Western States, which has been experienced since June of last year, was brought to a conclusion in April. The operations during the first quarter of the year were even below those of the same period last year, thereby reflecting the trend of general production prevalent throughout the nation as a whole. The April upward turn in the Western States is also a reflection of the national conditions of industry, April conditions in the Western States and in national industry as a whole being slightly above that of April last year. This higher rate of activity was continued during May. With June, however, came a downward trend which extended throughout practically all Western industry.

That the industries of the Western States will record new production figures during 1927 now seems probable. In fact, many economists and students of industry are now claiming that the remarkable high productivity of the manufacturing plants in the Western States and in the country as a whole during the past eighteen months has not been abnormal in nature, but has been even possibly sub-normal, when the natural growth of industrial production is given due consideration. This conclusion is especially applicable to the productive activity which has been witnessed by the manufacturing plants of the Western States during this period. This section of the nation is not only growing rapidly in population but is becoming more and more self-supporting industrially. The yearly increase in population is approximately 275,000, or equivalent to the adding to the section of a city of the size of San Francisco every two years. This increase in population represents a materially increased market for manufactured goods of no small proportions. To meet these new demands not only must more manufacturing plants be constructed, but a greater variety of commodities are being turned out by the manufacturing plants of this section, making more and more unnecessary the importation of such manufactured goods from the eastern industrial centers. Both of these basic tendencies must result in a material increase in the volume of commodities turned out by the manufacturing plants of the section.

For these reasons a decrease of production during June of only 3.6 per cent under June of last year, the record month for Western production, and 16.6 per cent over the monthly average for the three-year period 1923-1925, is not necessarily an indication of abnormal production by the manufacturing plants of the Western States. On the other hand the comparatively low rates of production from January to April by the manufacturing plants operating in this section might well serve as a basis for the conclusion that the apparently high industrial production witnessed during June was even sub-normal. There is every reason to expect an increase in the annual production by the manufacturing plants of this section of from 4 to 6 per cent over the previous year even in normal times.

"Electrical World" Barometer of Industrial Activity in the Western States

(Data Unadjusted for Seasonal Variation)